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Technical Memorandum Work Plan

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From: Lynn Grochala, Floyd|Snider

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Project No: BP2-BOE16, Task 6

Re: **Additional Characterization for OA-11 Interim Measure**

The Boeing Company (Boeing) is conducting an Uplands Corrective Measures Study at Boeing Plant 2 pursuant to the Administrative Order on Consent (Order; Resource Conservation and Recovery Act [RCRA] Docket No. 1092-01-22-3008(h)) issued to Boeing in 1994 by the U.S. Environmental Protection Agency (USEPA) under authority of RCRA Section 3008(h), as amended (42 USC 6928(h)).

A Draft Focused Corrective Measure Study (FCMS) for Other Area 11 (OA-11) was submitted to USEPA in October 2014 as Attachment S1B of the Draft Uplands Corrective Measure Study Volume X (CMS) for Plant 2 (EPI, et al. 2014) as required under the RCRA Order. As outlined in the CMS, Plant 2 has been divided into nine Remediation Areas (RAs). OA-11 is within the boundaries of RA 9. The RCRA program and Boeing have determined that the corrective measure for OA-11, which primarily consists of excavation of polychlorinated biphenyl- (PCB-) impacted soil, should be performed in summer 2016 to accelerate its schedule (given the current projected schedule for the Statement of Basis, it would not be performed until 2017 at the earliest) as an interim measure jointly with the Toxics Substances Control Act (TSCA) program under a Risk-Based Disposal Approval (RBDA). Accelerating this action will allow Boeing to complete property improvements necessary for stormwater compliance in that part of Plant 2. Therefore, the draft FCMS is currently being reviewed by the USEPA as a draft Interim Measure Work Plan.

The draft Interim Measure Work Plan provides sufficient details regarding PCB distribution, proposed excavation limits, material handling requirements, and post-construction monitoring. Extensive testing of soil in the area of OA-11 shows that PCBs and total petroleum hydrocarbons (TPH) are the chemicals of concern for OA-11. The additional characterization prior to construction proposed in this Technical Memorandum Work Plan will facilitate construction planning, including waste characterization and profiling, and will assist with further delineation of the excavation limits. Soil data collected during this investigation will also be used to supplement existing data, as excavation confirmation samples in areas where post-excavation sample collection cannot be performed due to the anticipated use of trench boxes or other means of sidewall shoring during excavation. The proposed excavation for OA-11 is scheduled to occur in late summer 2016. This technical memorandum provides specific details for the additional data collection proposed to supplement the existing data and to support the final remedial design and contracting for the OA-11 Interim Measure. Refer to Figure 1 for the general location of OA-11 at Plant 2, and refer to Figure 2 for a depiction of the OA-11 (RA 9) boundary and the proposed excavation area.

1.0 ADDITIONAL CHARACTERIZATION FOR OA-11

Soil in the vicinity of OA-11 has been extensively characterized by laboratory analysis of over 300 samples from over 50 borings. Although OA-11 is adequately characterized for purposes of establishing the overall objectives and work requirements of the Interim Measure Work Plan, additional and more detailed characterization is warranted prior to construction to facilitate segregation of materials for disposal (Subtitle C versus Subtitle D) and to further refine the excavation limits. Selected soil borings will also be advanced in areas where confirmation sample collection cannot be performed due to the anticipated use of trench boxes or other means of sidewall shoring during excavation. In addition, characterization of the concrete drainage trough prior to construction will facilitate material handling and disposal planning. The draft Interim Measure Work Plan will be updated to reflect data from this additional characterization work. Groundwater sample collection is also proposed from selected soil boring locations to facilitate future remedial planning for Corrective Measures Implementation (CMI) in accordance with RCRA, specifically associated with the former 2-66 sheetpile (RA 4), which is located adjacent to OA-11. Details regarding the additional characterization needs are included in the following sections. A more detailed description of sample collection means and methods is provided in Section 2.0.

1.1 Additional Soil Characterization

Soil borings will be advanced to a target depth of 15 feet below ground surface (bgs) using direct-push drilling methods. Soil cores will be collected continuously using a 5-foot-long lined sampler and soil samples will be collected from more discrete intervals within each 5-foot core. Additional data characterization for soil will be completed as described in the following subsections. Refer to Figure 3 for the proposed soil boring locations. A summary of proposed soil sample collection by location and depth is included in Table 1.

1.1.1 Soil Borings to Further Delineate PCB Concentrations Greater than 50 parts per million

PCB concentrations greater than 50 parts per million (ppm) are limited to within the footprint of the Area of Discovery (refer to Figure 3). Although a significant mass in the Area of Discovery was previously excavated by Boeing in 2001, post-excavation samples confirmed that high concentrations of PCBs remained in the subsurface after the completion of excavation. There are two existing locations within the Area of Discovery with soil concentrations greater than 50 ppm (refer to Figure 3), with a maximum PCB concentration of 660 ppm (soil boring SB-07221) at a depth interval of 6.5 to 8 feet bgs. The Area of Discovery with the greatest PCB concentrations does not contain TPH. It is important to note that the Area of Discovery has been depicted on many plans over the past 15 years, and recent field observations confirmed that it has been shown about 10 feet east of its actual location and has been depicted as having various areal extents. The location has been adjusted on Figures 2 through 4, and is documented further in the Field Verification of Area of Discovery Boundary included in Attachment 1.

Four soil borings (OA11-DP05 through OA11-DP08) are proposed to further define the lateral and vertical extent of PCB concentrations greater than 50 ppm associated with the Area of Discovery. The additional soil data will facilitate material handling, segregation, and disposal coordination prior to excavation. A total of five soil samples will be collected from each boring in this area to provide better vertical profiling. Samples will be collected from the 2- to 4-, 4- to 6-, 6- to 8-, 8- to 10-, and 10- to 12-foot bgs intervals. Initially, only samples from the 2- to 4-, 6- to 8-, and 8- to 10-foot bgs intervals will be analyzed; soil samples from the 4- to 6- and the 10- to 12-foot bgs intervals will be archived at the laboratory. If results from the initial three analyses do not clearly indicate that PCB concentrations are less than 50 ppm after consideration of the allowable accuracy and precision of the analytical data or if additional vertical delineation is warranted (i.e., concentrations remain greater than the Final Media Cleanup Level [FMCL]), archived samples from additional depth interval(s) will also be analyzed to provide more detailed vertical concentration profile. Soil samples collected from soil borings will be analyzed for PCB Aroclors by USEPA Method 8082. Soil data will be compared to both the TSCA 50 ppm criteria to determine the as-found concentrations of PCBs to establish the disposal pathway (i.e., Subtitle C versus Subtitle D) and the proposed FMCLs to confirm that proposed excavation lateral extent and depth(s) are sufficient. Any necessary changes to the proposed excavation depth will be documented further in the revised draft Interim Measure Work Plan, which will be submitted to USEPA in the next few months.

1.1.2 Soil Borings to Further Delineate the Extent of Excavation at Jorgensen Forge

The southern limits of OA-11, including the Area of Discovery, is located along the property and fence line adjacent to the Jorgensen Forge property. The proposed excavation currently extends a few feet onto the Jorgensen Forge property immediately adjacent to the Area of Discovery and will require the temporary removal of a section of the property line fence and access onto the Jorgensen Forge property. Three additional soil borings (OA11-DP09 through OA11-DP11) will be advanced adjacent to the Area of Discovery on the Jorgensen Forge property to determine the lateral extent of PCBs specific to the Area of Discovery, and to verify that excavation to the line defined by the three soils borings will ensure all soils with PCB concentrations greater than the proposed FMCLs will be excavated. Access to Jorgensen Forge is necessary to advance these soil borings. Soil samples will be collected from each soil boring, consistent with the Area of Discovery soil sampling scheme described in Section 1.1.1 and in Table 1.

If data from any of these three sampling locations indicate that PCB concentrations are greater than the proposed FMCLs, Boeing and Jorgenson Forge will discuss the results with the USEPA RCRA and TSCA programs to establish a path forward for addressing any additional contamination that may exist to the south of the three soil borings. However, the scope of the excavation for the OA-11 project will not be expanded to the south past the administrative boundary corresponding to the line defined by soil borings OA11-DP-09 through 11.

1.1.3 Soil Borings to Verify Excavation Depth in the 14-foot Depth Excavation Footprint

This north and western portion of the proposed excavation extends to 14 feet bgs in a T-shaped area, approximately 37 feet long by 10 feet wide and 25 feet long by 10 feet wide, as shown in blue on Figure 3. Both PCBs and TPH are present within this footprint at depths below the water table, which is typically 10 feet bgs, and there is a limited data set in this portion of the proposed excavation, which was collected more than 10 years ago. Two soil borings (OA11-DP01 and OA11-DP02) will be advanced in this area to better delineate the lateral extent and depth of the proposed 14-foot depth footprint. A total of four soil samples will be collected from each boring in this are to provide better vertical profiling. Samples will be taken from the 8- to 10-, 10- to 12-, 12- to 14-, and 14- to 15-foot bgs intervals. Initially, only samples from the top three intervals will be analyzed. If results from these three analyses do not indicate that the proposed FMCLs for TPH and PCBs will be achieved through excavation to a 14-foot depth, then, samples from the 14- to 15-foot bgs depth interval(s) will also be analyzed to provide more detailed vertical concentration profile information. Soil samples collected from soil borings will be analyzed for PCB Aroclors by USEPA Method 8082 and for TPH by the NWTPH-Dx method, to quantify diesel, heavy oil, and mineral spirit/Stoddard solvent ranges. Soil data will be compared to the proposed FMCLs to confirm that proposed excavation extent (vertical and horizontal) will achieve cleanup goals of meeting the proposed FMCLs. If the data are less than the proposed FMCLs, then the proposed excavation limits will be deemed sufficient; if the data are greater than the proposed FMCLs, then excavation limits will be adjusted accordingly to assure that the excavation will meet cleanup objectives. If the excavation limit(s) are expanded beyond what is currently proposed, additional data will be collected during construction to confirm revised extents are sufficient to meet cleanup objectives. Any necessary changes to the proposed vertical or horizontal extent of excavation will be documented further in the revised draft Interim Measure Work Plan, which will be submitted to USEPA in the next few months.

1.1.4 Soil Borings to Verify Excavation Extents outside the Area of Discovery

Three soil borings (OA11-DP03, OA11-DP04, and OA11-DP12) will be advanced to further delineate the lateral and vertical limits of the proposed excavation in areas with limited data density: one in the 12-foot depth footprint, one in the 8-foot depth footprint, and one in the 4-foot depth footprint. A total of five soil samples will be collected from each boring in these areas to provide better vertical profiling. Samples will be collected from the 2- to 4-, 4- to 6-, 6- to 8-, 8- to 10-, and 10- to 12-foot bgs intervals. Initially, only samples from the 2- to 4-, 6- to 8-, and 8- to 10-foot bgs depth intervals will be analyzed. If results from these three analyses do not indicate that the proposed FMCLs for TPH and PCBs will be achieved for the target depths, archived samples from the remaining depth interval(s) will be analyzed to provide more detailed vertical concentration profile information. Soil samples collected from soil borings will be analyzed for PCB Aroclors using USEPA Method 8082 and for TPH by NWTPH-Dx method to quantify diesel, heavy oil, and mineral spirit/Stoddard solvent ranges. Soil data will be compared to the proposed FMCLs to confirm that proposed excavation extent (vertical and horizontal) is sufficient as proposed. Any necessary changes to the proposed excavation depth will be documented further in the revised draft Interim Measure Work Plan, which will be submitted to USEPA in the next few months.

1.1.5 Soil Sample Collection to be used as Confirmation Samples

Confirmation[1] sampling to verify cleanup of PCBs will occur in accordance with TSCA 40 CFR §761.61 (c). The proposed confirmation sampling scheme outlined in this section is intended to provide sufficient sampling density (horizontal spacing every 15 to 20 feet) when combined with existing data within the proposed excavation area (presented on Figure 3) to establish that cleanup objectives will be met, and that the TSCA no unreasonable risk standard will be met. The entire excavation area will be covered with an impermeable surface (asphalt) subsequent to the completion of construction.

Due to potential limitations associated with sidewall sample collection when construction means and methods necessitate the use of sidewall shoring (such as trench box use) and bottom sample collection below the water table, soil samples from this additional characterization field effort will be used to supplement existing data and post-excavation confirmation data to document that soil cleanup to proposed FMCLs is achieved. Five soil borings (OA-11-DP13 through OA-11-DP-17) will be advanced in the 12-foot and 14-foot excavation depth areas, where it may be difficult to collect representative sidewall and bottom samples. In addition, soil samples from soil borings collected as part of this investigation for other purposes will also be used as confirmation samples due to their proximity to sidewalls (OA11-DP02, OA11-DP03, and OA11-DP-09 through 11). All bottom samples collected during this investigation will be used as confirmation samples for the bottom, as appropriate (i.e., if the bottom sample from the boring represents the bottom depth of the excavation).

In the 12-foot portion of the excavation, sidewall samples will be collected at approximately 5 to 6 feet bgs. In the 14-foot portion of the excavation, sidewall samples will be collected at approximately 6 to 7 feet bgs. A total of three soil samples will be collected from each of the four borings in these areas to provide vertical profiling of the sidewalls. Samples will be collected from the 4- to 6-, 6- to 8-, and 8- to 10-foot bgs intervals. Additionally, a soil sample will be collected from the 12- to 13-foot interval from soil boring OA11-DP17 to be representative of the 12-foot bottom, and samples will be collected from the 14- to 15-foot interval in soil borings OA11-DP-13

[1] Verification sampling for TSCA is intended to serve as confirmation sampling under RCRA. Because the primary Order for this work is RCRA, the term confirmation has been used.

through 16 to be representative of the 14-foot bottom. Soil samples will be analyzed for PCB Aroclors using USEPA Method 8082 and for TPH by NWTPH-Dx method to quantify diesel, heavy oil, and mineral spirit/Stoddard solvent ranges.

Soil data will be compared to the proposed FMCLs and will be used to define the final excavation footprint. The results of the confirmation samples will be documented in the revised draft Interim Measure Work Plan, which will be submitted to USEPA in the next few months. If any data gaps remain related to confirmation sampling, additional sampling (post-excavation) will be proposed in the draft Interim Measures Work Plan.

1.1.6 Soil Sample Collection to Evaluate Contained-In Requirements

Chlorinated solvents, specifically trichloroethene (TCE) and its lesser chlorinated breakdown products, were present in historical soil samples in OA-11 and are associated with the releases otherwise contained by the 2-66 Sheetpile Interim Action. TCE is considered a hazardous waste, as is environmental media contaminated with a listed hazardous waste. However, in accordance with Washington State Department of Ecology's (Ecology's) contained-in policy, a determination can be made by Ecology that an environmental media (i.e., soil) that contains a hazardous waste may no longer be considered hazardous if the hazardous substances are present in environmental media at concentrations less than risk-based levels identified by Ecology.

TCE is present in OA-11 as a low concentration halo around the outside of the sheetpile containment as a result of a historical release from a former TCE degreaser and/or tank and associated product piping that were present at the current 2-66 Sheetpile location. The impacted soil and groundwater associated with this release are being addressed separately as part of the RCRA cleanup for the 2-66 Sheetpile wall area (RA 4), which is adjacent to OA-11. None of the recent (post-2005) soil concentrations in the OA-11 area exceed the TCE industrial Proposed FMCL and, therefore, do not require remediation under RCRA. Because proposed FMCLs are met for TCE in soil in the OA-11 area, samples have not been recently collected from within the proposed excavation area footprint, which is adjacent to RA 4. Samples within the excavation footprint are necessary to evaluate whether or not TCE and any of its breakdown products (such as vinyl chloride) are present at concentrations greater than Ecology's risk-based concentrations, which are much less that the proposed industrial FMCLs. If so, soil excavated as part of the OA-11 interim measure must be managed in accordance with Ecology's contained-in policy as discussed below.

Because of the potential for detectable TCE and its lesser-chlorinated breakdown products such as vinyl chloride in soil from the 2-66 Sheetpile Area, selected soil samples will be collected and analyzed for chlorinated volatile organic compounds (cVOCs) by USEPA SW846 Method 8260C to evaluate whether or not a contained-in determination from Ecology would be needed for disposal of the excavated soil. For the purpose of this investigation, cVOCs specifically means the chlorinated ethenes: TCE, the three dichloroethene (DCE) isomers (*cis*- and *trans*-1,2-DCE and 1,1-DCE), and vinyl chloride. One soil sample will be collected from a discrete depth between approximately 8 and 10 feet bgs (above the water table), which has historically contained the highest TCE concentrations in soil, from soil borings OA11-DP01, OA11-DP02, OA11-DP03, and OA11-DP4 (i.e., four samples), which are closest to the 2-66 Sheetpile Area. Three additional samples will be collected from soil borings OA11-DP01 and DP-03 (between approximately 4 and 6 feet bgs) and OA11-DP02 (between approximately 10 and 12 feet bgs) to evaluate shallower and deeper soil that will be excavated. The soil samples will be collected and preserved using USEPA Method 5035 and analyzed for cVOCs using USEPA Method 8260C.

If cVOCs are not present at concentrations greater than laboratory reporting limits (provided laboratory reporting limits are less then Ecology's risk-based concentrations for unrestricted use), then a contained-in determination will not be necessary for management and disposal of the OA-11 excavated soils. If cVOCs are detected at concentrations greater than laboratory reporting limits, then the data will be provided to Ecology as part of a contained-in determination request. A summary of analytical data and sample collection details will be provided in a contained-in request letter. It may take Ecology up to 2 weeks to provide the contained-in determination; therefore, the request will be submitted to Ecology with sufficient time prior to excavation for a determination to be made. Having the contained-in determination prior to initiating excavation will allow for direct loading of excavated soil for transport to a permitted Subtitle D landfill, thus minimizing the need for stockpiling excavated soil at the Site.

1.2 Stormwater Infrastructure Characterization

Concrete samples will be collected from the concrete drainage trough prior to construction to facilitate material handling and disposal planning. Other concrete stormwater structures (vault and storm drain manhole [SDMH]) will be characterized during construction. These inactive stormwater features will be removed as part of the Interim Measure, along with former stormwater conveyance pipes that are located within the limits of the proposed excavation. Refer to Figure 2 for the location of these stormwater features. All concrete samples will be analyzed for PCB Aroclors by USEPA Method 8082. Sample results will be compared to the TSCA criteria of 50 ppm to determine if the concrete can be disposed of at a Subtitle D landfill (if PCB concentrations are less than 50 ppm) or if they require disposal at a Subtitle C facility (if PCB concentrations are greater than or equal to 50 ppm).

1.2.1 Concrete Drainage Trough in the Area of Discovery

A portion of the concrete drainage trough was removed by Boeing during the Area of Discovery excavation in 2001. The portion of the concrete trough between the Area of Discovery and the stormwater vault is still present (refer to Figure 2) and is approximately 20 to 25 feet long and a few feet wide. The trough is relatively flat and is estimated to be six inches thick. A total of three concrete samples will be collected from the surface of this drainage trough using a concrete corer mounted to the drill rig. The samples will be evenly spaced across the length of the trough. The lateral extents of this trough will also be confirmed during the field sampling event to facilitate construction and disposal planning.

1.3 Additional Groundwater Characterization

Groundwater data collected in 2006 as part of the Data Gap Investigation of the 2-66 Area (RA 4) indicate that shallow (A-Level) groundwater within the western portion of the OA-11 proposed excavation footprint historically contained TCE and other cVOCs at concentrations greater than their proposed FMCLs (EPI/Golder 2007). The soil characterization work proposed in this technical memorandum that is intended to facilitate segregation of materials for disposal and further refine the excavation limits also provides an opportunity to evaluate current groundwater conditions in the area associated with RA 4 to determine whether cVOCs are still present in groundwater at concentrations greater than their proposed FMCLs. These additional data will be evaluated along with historical data to assist with remedial design considerations for the RA 4 cleanup under RCRA. The updated groundwater data provided by this investigation are important because it has been approximately 10 years since groundwater samples have been collected in this area.

Groundwater samples will be collected from seven of the proposed direct-push probe sampling locations; refer to Figure 4 for the soil borings that are also proposed temporary groundwater sample locations. Groundwater samples collected from these locations will be analyzed for cVOCs by USEPA Method 8260C. For the purpose of this investigation, cVOCs specifically means the chlorinated ethenes: TCE, the three DCE isomers, and vinyl chloride. For those cVOC constituents associated with Method 8260C and for which FMCLs have been established, groundwater data will be compared to the proposed FMCLs to support remedial planning and decision making for the CMI under RCRA.

2.0 SAMPLE COLLECTION, IDENTIFICATION, AND ANALYSES

The additional characterization data collection will involve collecting soil, concrete, and groundwater samples for laboratory analyses at the locations shown on Figures 3 and 4, with general sampling procedures described below, including field methodology, sample nomenclature, and sample handling and custody documentation. Additional details regarding soil and groundwater sampling procedures are included in the Standard Guidelines included in Attachment 2.

2.1 Sample Identification

Soil, concrete, and groundwater samples collected as part of this investigation will be identified and labeled as follows:

- Soil samples: OA11-DP-boring number-sample depth or interval (i.e., OA11-DP01-2)
- Concrete samples: OA11-concrete-trough -directional location description (i.e., OA11-concrete-trough-E)
- Groundwater Samples: OA11-DP-GW-boring number-top of screen depth (i.e., OA11-DP-GW-01-10)

2.2 Soil Sample Inspection and Collection Methods

Soil borings will be advanced to a depth of 15 feet bgs, or as close to this depth as possible if there is refusal, using direct-push drilling methods and soil cores will be collected continuously using a 5-foot-long lined sampler. All soil borings will be observed by a field technician, logged, classified according to the Unified Soil Classification System (USCS), and photographed.

Soils will be inspected for visual (e.g., light non-aqueous phase liquid [LNAPL], staining, or sheen) and/or olfactory indicators of contamination. Soil headspace will be field screened for volatile organic compounds (VOCs) using a photoionization detector (PID) to identify potential petroleum or solvent impacts and to evaluate ambient air quality for health and safety purposes during drilling. Soil from approximately 2-foot or smaller representative intervals will be collected in a sealed and labeled bag or jar. After soil vapor has had time to approach equilibration with headspace gas, soil headspace will be screened with the PID; results will be noted on the field log.

For PCB and TPH sample collection, soil samples from discrete intervals (e.g., 6 to 8 feet bgs) will be transferred to a decontaminated stainless steel bowl and homogenized until uniform in color and texture before being placed into laboratory-provided sample containers.

For VOC sample collection by USEPA Method 5035, selected soil samples will be collected first before disturbing the soil. This method uses a laboratory-provided soil volume gauge fitted with a disposable soil sampling plunger tube to collect a soil plug that can be discharged directly to a laboratory-cleaned 40-milliliter (ml) volatile organic analysis (VOA) vial containing appropriate preservative (methanol or sodium bisulfate), limiting the loss of volatiles during sampling.

2.3 Concrete Sample Collection Methods

Concrete core samples will be collected from the surface of the concrete to a depth of 1 inch into the concrete surface (additional samples may be collected until sufficient volume for sample collection is achieved) using a coring device mounted to a drill rig to obtain representative samples of the concrete trough identified in Section 1.2. Samples will be collected in general accordance with EPA's draft Standard Operating Procedure for sampling concrete in the field (USEPA 1997). Concrete samples, which will consist of concrete dust generated by using a drill core, will be placed in a laboratory-cleaned unpreserved 8-ounce glass jar. Concrete samples that consist of chips or small chunks, in lieu of dust, will be crushed at the laboratory prior to laboratory analysis. All concrete samples will be analyzed for PCB Aroclors by USEPA Method 8082.

2.4 Groundwater Sample Collection Methods

Groundwater samples will be collected from seven of the temporary direct-push probe locations as indicated in Figure 4. Groundwater samples will be collected from the top of the uppermost aquifer by setting temporary 4-foot screens through the probe rods at intervals that extend approximately 3 feet into the aquifer. Based on historical water level data for the area, the temporary screens are anticipated to be installed in approximately the 9- to 13-foot bgs interval, and will be adjusted in the field to intersect the groundwater table should the water table be identified shallower or deeper than expected. Sampling procedures that will be followed for groundwater sample collection are included in the Standard Guideline for Groundwater Sample Collection with a Direct-Push (i.e., Geoprobe™) Drill Rig, included in Attachment 2. Additional specific procedures for groundwater sampling as part of this additional characterization task are presented in the following sections.

2.4.1 Water Level Measurements

Depth to water will be measured using a decontaminated electronic water level indicator at the seven probe locations that will be sampled for groundwater. These data will be used to document where the top of the water table intersects each of the temporary 4-foot screened intervals, calculate purge volume, and to provide general groundwater level information for the proposed excavation work that will be performed at OA-11, and will not be used to evaluate groundwater flow direction or rate. Depth to water will be measured relative to the ground surface to an arbitrary datum using a water level meter with a precision of 0.01 feet and will be recorded in a field notebook. The probe portion of the water level indicator will be decontaminated prior to use and between locations.

2.4.2 Groundwater Purging

Probe locations (refer to Figure 4) used for groundwater sample collection will be purged prior to sampling using a peristaltic pump equipped with new, single-use tubing. Field staff will purge a minimum of three well volumes of water from each probe to reduce sample turbidity to visually acceptable levels and to provide field parameter data per the guidance presented in Attachment 2. To the extent practical, purging from temporary well screens should be conducted using a low-flow rate to minimize drawdown during purging. In general, purging should start at the lowest flow rate achievable with a peristaltic pump and increase to a rate of approximately 0.5 liters per minute. To the extent possible, probes will not be purged to dryness. However, if a probe exhibits very slow water level recovery and is purged to dryness, groundwater samples will be collected upon sufficient recovery. Sufficient recovery is considered as recovery to at least 80 percent of original static water level prior to purging.

2.4.3 Field Parameter Measurements

During purging, field staff will periodically measure and record pH, dissolved oxygen, temperature, conductivity and oxidation-reduction potential using a multi-parameter water quality meter. A flow-through cell will be used to the extent possible during field parameter measurements to reduce the effects of atmospheric gases on field parameter results. The field parameter measurements, particularly dissolved oxygen and oxidation-reduction potential, will be used to evaluate current geochemical conditions (i.e., oxidizing or reducing) of the aquifer.

Evaluating if the aquifer is under oxidizing or reducing geochemical conditions is important because it can affect the design or implementation of the Enhanced Reductive Dechlorination (ERD) groundwater technology that has been proposed as a remedial alternative for RA 4.

2.4.4 Groundwater Sample Collection

Following purging, groundwater samples will be collected using a peristaltic pump equipped with new, single-use tubing. The tubing portion of each pump will be discarded after use (between each probe). Nitrile gloves will be changed, at a minimum, between probes and whenever the potential for cross-contamination is suspected.

Groundwater samples for cVOC analyses will be pumped into laboratory-cleaned, pre-labeled, and preserved 40-ml VOA vials using the slowest pumping rate as reasonably achievable with the peristaltic pump. These samples should have no headspace in the container after filling. To check for headspace, VOA vials will be capped, inverted, and struck on the palm of the sampler's hand to check for air bubbles. If air bubbles are noted the lid should be removed and the sample vial should be topped off, resealed, and rechecked for air bubbles. This process should be repeated until a zero headspace sample is achieved.

2.5 Sample Handling and Analyses

Prior to transport, sample containers will be wrapped and securely packed inside the sample cooler with ice packs or crushed ice by the field technician to maintain sample preservation temperature of 4 °C. Samples will be delivered to the analytical laboratory under chain-of-custody protocol following completion of sampling activities on the day of sample collection or the following day depending on the field sampling duration and courier availability.

Soil samples collected from soil borings will be analyzed for PCB Aroclors by USEPA Method 8082 (total PCBs will be summed for comparison to proposed FMCLs). Selected soil samples will also be analyzed for TPH by NWTPH-Dx and cVOCs by USEPA Method 8260C. Concrete samples will be analyzed for PCB Aroclors by USEPA Method 8082 using extraction methods suitable to ensure complete extraction from the sample (i.e., microwave extraction, SW-846 Method 3546). Groundwater samples will be analyzed for cVOCs by USEPA Method 8260C. Sample containers, preservation, and holding times for these analyses are summarized in Table 2.

3.0 QUALITY ASSURANCE PROJECT PLAN

This section describes the analytical program to be conducted for each sample selected for chemical analysis, as well as the laboratory quality assurance (QA) objectives and quality control (QC) procedures required to be met to achieve technically sound and useable data. Samples will be transported to Analytical Resources, Inc. (ARI) located in Tukwila, Washington for chemical analysis of PCBs, TPH, and cVOCs using the analytical methods provided in Table 2. Laboratory data quality objectives (DQOs), including detection limits and reporting limits for the selected analytical methods, are presented in Table 3.

3.1 Data Quality Objectives

The additional data collection proposed herein is not intended to significantly alter the current proposed interim measure for OA-11. As described in Section 1.0, the primary objectives for this investigation are to supplement existing data to allow the following pre-construction planning tasks to be completed prior to implementation of the interim measure.

- Waste characterization and profiling for soil and concrete to facilitate materials handling during construction and minimize the need for stockpiling.
- Further refinement of the vertical and horizontal soil excavation limits, which will be defined by comparison of data to the proposed FMCLs. Consideration of the allowable accuracy and precision of the analytical data will be taken into account as part of this evaluation as discussed below.
- Further delineation of PCBs with concentrations at or greater than 50 ppm in the Area of Discovery. For the purpose of this investigation, PCB concentrations greater than 40 ppm will be used to define the limits of the 50 ppm or greater area that will be segregated for Subtitle C disposal.
- Supplementing existing data for use as confirmation samples in areas where construction means and methods (i.e., use of trench box) would make it difficult to collect representative sidewall samples.
- Evaluating current groundwater conditions in the OA-11 area associated with RA 4 to determine whether cVOCs are still present in groundwater at concentrations greater than their proposed FMCLs. Field measurements of geochemical data collected during groundwater sample collection will also be evaluated to supplement design data for implementation of the ERD groundwater technology that has been proposed as a remedial alternative in RA 4. These are considered samples of opportunity and are not directly associated with OA-11 construction planning.

These objectives have been used to define the following DQOs:

- The data must be representative of the media and relevant to the objective listed; this DQO is addressed by the design of the investigation as described in this technical memorandum work plan.
- The analytical methods used to make the measurements must be selected to allow the data to be used in meeting the objectives. This DQO is addressed by using standardized USEPA methods that have been performing at the site for years without known matrix problems or interferences. These methods are listed in Table 3. For TPH, silica gel cleanup will be used. For cVOCs, only a short list of five chemicals are included; numerous previous analyses in this area for VOCs have indicated that other organics that could potentially interfere are not present.

- The analytical methods used to make measurements must be sufficiently sensitive to allow the objectives to be met. Specifically:
- The reporting limits in combination with the requirements for precision and accuracy shown in Table 3 will allow the results to be distinguished from decision criteria listed in Table 3. The decision criteria listed are the lowest of the various criteria listed herein for making decisions for a specific analyte in a specific medium.

The additional soil and concrete data will be incorporated into the revised draft Interim Measure Work Plan, which will be submitted to USEPA in the next few months. This report will document proposed changes to the current proposed excavation limits and the associated decision-making criteria used for adjustments. Any additional data needs that are deemed necessary for implementation of the interim measure will be documented in the revised draft Interim Measure Work Plan and collected during construction in accordance with the USEPA-approved Interim Measure Work Plan for OA-11 (expected summer 2016).

The additional groundwater data will be evaluated along with historical data to assist with remedial design considerations for the RA 4 cleanup under RCRA.

3.2 Reporting Limits

The analytical methods identified in this technical memorandum result in method detection limits and reporting limits (or Practical Quantitation Limits) that are low enough to be less than the proposed FMCLs and other relevant comparison criteria discussed herein (i.e., TSCA threshold of 50 ppm). Table 3 presents the target method detection and reporting limits for each analytical method that will be performed under this scope by ARI. These reporting limits are goals only, insofar as instances may arise where high sample concentrations, non-homogeneity of samples, or matrix interferences preclude achieving the desired reporting limit and associated QA/QC criteria. In such instances, the laboratory will report the reason for any deviation from these reporting limits.

If the achieved quality of the data would limit its use, then the sample would be re-extracted and/or re-analyzed. For example, an elevated reporting limit for PCBs in soil from 20 µg/kg to 50 µg/kg when compared to a minimum decision criterion of 1,000 µg/kg would not trigger reanalysis, whereas a raised reporting limit of 900 µg/kg would.

3.3 Laboratory Quality Assurance/Quality Control Objectives

Laboratory QA/QC objectives include obtaining data that are technically sound and properly documented, having been evaluated against established criteria for the principle data quality indicators (i.e., precision, accuracy, representativeness, completeness, and comparability) as defined in USEPA guidance (USEPA 2002). Laboratory results will be evaluated against DQOs by reviewing results for analysis of method blanks, matrix spikes (MS), duplicate samples, laboratory control samples (LCS), calibrations, performance evaluation samples, and interference checks as specified by the specific analytical methods.

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, precision is a quantitative measure of the variability of a group of measurements compared to their average values. Precision, defined as the relative percent difference (RPD) between results, will be evaluated for both laboratory MS/matrix spike duplicate (MSD) and field duplicate samples. Duplicate samples will be collected at a minimum frequency of 1 per laboratory analysis group and 1 per 20 field samples. Performance criteria have not been established for field duplicates. Field duplicate precision will, therefore, be screened against a RPD of 75 percent for all samples. However, no data will be qualified based solely on field duplicate precision. As shown in Table 3, data that meet the detection limit, accuracy, and precision requirements listed will be useable for decision-making.

Accuracy is an expression of the degree to which a measured or computed value represents the true value. Analytical accuracy may be assessed by analyzing "spiked" samples with known concentrations (surrogates, LCSs, and/or MS) and measuring the percent recovery. Accuracy measurements on MS samples will be carried out at a minimum frequency of one per laboratory analysis group per matrix analyzed. Because the soil samples are expected to contain PCBs at concentrations greater than the detection limits, a concentrated spiking solution corresponding to between 1 mg/kg and 10 mg/kg in soil will be used for the MS and MSD samples.

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Care has been taken in the design of the sampling program to ensure sample locations are properly selected, sufficient numbers of samples are collected to accurately reflect conditions at the location(s), and samples are representative of the sampling location(s). A sufficient volume of sample will be collected at each sampling location to minimize bias or errors associated with sample particle size and heterogeneity.

Completeness, defined as the number of acceptable data points relative to the total number of data points, will be assessed for all samples within a given media (i.e., soil, concrete, or water). The QA/QC objectives for completeness for all components of this project is 95 percent. Data that were qualified as estimated because the QA/QC criteria were not met will be considered valid for the purpose of assessing completeness. Data that have been qualified as estimated will be further reviewed for usability. For this project, the primary use of the data is to compare to standards for making decisions regarding waste disposal and compliance with soil cleanup levels. The flagged laboratory result will be compared to the waste disposal standard or proposed FMCL (whichever is appropriate for the decision). If the measured result is close enough to the decision criteria that the decreased precision or accuracy (the reason for the J flag) would limit the power of the decision by more than half, then the decision will be identified and flagged for discussion with USEPA. Data that were qualified as rejected will not be considered valid for the purpose of assessing completeness. If a sample medium has an unacceptable completeness percentage after comparison to the individual DQOs described above, original samples will be re-analyzed if sufficient sample volume is available, archived samples will be analyzed if appropriate, or additional samples will be obtained during construction.

Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared to another. In order to insure results are comparable, samples will be analyzed using standard USEPA methods and protocols. Calibration and reference standards will be traceable to certified standards and standard data reporting formats will be employed. Data will also be reviewed to verify that precision and accuracy criteria were achieved and, if not, that data were appropriately qualified.

3.4 Laboratory and Field Quality Assurance/Quality Control Procedures

The quality of analytical data generated is assessed by both the implementation of field QC procedures, and by the frequency and type of internal laboratory QA/QC checks developed for analysis type and method. Field QC is evaluated through the analysis of trip blanks, rinsate blanks, and blind field duplicates. Rinsate blanks are collected from non-dedicated field equipment (i.e., stainless steel bowl and spoon) to ensure field decontamination procedures are effective. Blind field duplicates are collected to evaluate the efficiency of field decontamination procedures, variability from sample handling, and sample heterogeneity. Laboratory results will be evaluated by reviewing analytical results of method blanks, MS/MSD, field duplicate samples, LCS, calibrations, performance evaluation samples, and interference checks as specified by the specific analytical methods.

To monitor for cross-contamination from volatiles during sample collection and handling, laboratory-provided trip blanks will be included in all coolers containing samples for VOC analysis. The trip blank samples will be analyzed for cVOCs by USEPA Method 8260C. One rinsate blank per sample collection method will also be collected from all reusable sampling equipment and analyzed for PCBs, which have the greatest tendency to adsorb to soil particles of the compounds targeted for analysis during this investigation, to evaluate the effectiveness of field decontamination procedures. Any detection in trip blank or rinsate blank samples greater than the laboratory method detection limits would be an indication of possible cross-contamination and may need to be qualified.

3.5 Data Validation

Floyd|Snider will conduct a Level I Compliance Screening on all the analytical data. All chemical data will be reviewed with regard to the following:

- Chain-of-custody/documentation
- Sample preservation and holding times
- Method blanks
- Reporting limits

- Surrogate recoveries
- MS/MSD recoveries
- LCS recoveries
- Laboratory and field duplicate RPDs

Data usability, conformance with the QA/QC objectives, and any deviations that may have affected the quality of the data, as well as the basis of application of qualifiers, will be included in the final reporting of the data.

4.0 GENERAL FIELD PROCEDURES

The following paragraphs summarize general health and safety, decontamination, and excess material disposal procedures that will be followed during the additional characterization field activities.

4.1 Health and Safety

The work will be conducted in accordance with a site-specific HASP (Attachment 2) and workers will wear the appropriate personal protective equipment, which is expected to be Level D based on existing data. A daily safety briefing will be performed prior to any field work. Contractors and/or subcontractors will be required to provide their own HASP for tasks completed for the project (such as drilling or concrete sampling) prior to their work.

Concrete sample collection within the stormwater vault and SDMH will require confined space entry and will be conducted using confined space entry procedures by qualified and trained contractors. In addition, Boeing confined space entry procedures, including permit-required confined space protocols, will also be followed.

4.2 Decontamination Procedures

The appropriate use of field equipment and decontamination protocols will be followed to minimize or eliminate the potential for cross-contamination. All surfaces (interior and exterior) of downhole components such as probe rods that have come into contact with potentially contaminated media will be decontaminated before use and between soil boring locations. Particulate matter and surface film will be removed using a brush followed by hot water pressure washing using potable water and Liquinox® detergent, or equivalent. Additionally, direct-push rods will be fitted with disposable plastic liners for sample collection to ensure that sample material does not come into contact with the interior of the direct-push rod. This process is the industry standard of care for decontamination of downhole drilling equipment.

Decontamination wash water will be containerized and profiled for treatment or for off-site disposal. If there is a small volume of water (less than a drum), it can alternatively be taken to Boeing Field for treatment and subsequent discharge under their King County discharge permit.

4.3 Excess Material Disposal

A small amount of investigation-derived waste (IDW) is expected to be generated as part of this work. Soil borings advanced using a direct-push probe are not expected to generate more than a small volume (less than a drum) of excess soil, as most soil will be collected for laboratory analysis. If excess soil is generated, it will be managed as IDW in accordance with applicable state and federal regulations. Excess soil will be placed in a drum, labeled as IDW pending characterization, and temporarily stored at Plant 2 in a secure location for bulk disposal concurrent with excavation. If soil characterization data show that PCBs are present at concentrations greater than or equal to 50 ppm in any given sample associated with a particular drum (or drums) of IDW, then the entire drum(s) will be transported to a Subtitle C facility for disposal in accordance with TSCA.

Purge water from groundwater sample collection will be temporarily contained in 5-gallon buckets, or equivalent. After purging, the buckets will be consolidated into a Department of Transportation approved 55-gallon steel drum, sealed, and labeled for subsequent treatment or off-site disposal.

All miscellaneous solid waste, such as personal protective equipment and disposable sampling equipment will be containerized or bagged in heavy-duty plastic bags, and disposed of as municipal solid waste.

Waste derived from activities on Jorgensen Forge property (excess soil and purge water) will be transferred to Boeing property through a property line fence gate, and will be consolidated and managed as IDW in accordance with applicable state and federal regulations.

4.4 Survey and Decommissioning

After soil and groundwater sampling are completed, the soil boring locations will be measured from fixed points and marked for surveying to document sample locations. Probe location elevations will be surveyed from the National Geodetic Vertical Datum of 1929 (NGVD 1929) to an accuracy of within 0.01 foot. Horizontal control accuracy will be within 0.1 foot.

Following the completion of soil and groundwater sampling, each boring hole will be decommissioned following Ecology's borehole decommissioning regulations found in Washington Administrative Code (WAC) 173-160-460.

5.0 DATA REVIEW AND REPORTING

Upon receipt, and following data validation, the analytical results will be reviewed, entered into the Boeing database, and tabulated for comparison to the proposed FMCLs, Ecology's contained-in criteria, and/or TSCA remediation levels, as appropriate. Within 45 days of data validation, the results of this investigation will be submitted to USEPA in a data technical memorandum that will include a summary of activities, data summary tables, figures, and laboratory reports. The results will be used to refine the OA-11 Interim Measure limits of excavation and will be included as part of a revised draft Interim Measure Work Plan or Interim Measure Work Plan Addendum, if warranted.

REFERENCES

Environmental Partners, Inc. and Golder Associates, Inc. (EPI/Golder). 2007. *Uplands Corrective Measures Study Volume Vb: 2-66 Area Data Gap Investigation Report.* Prepared for The Boeing Company. October.

Environmental Partners, Inc., Floyd|Snider, and Golder Associates, Inc. (EPI, et al.). 2014. *Draft Uplands Corrective Measures Study, Volume X Corrective Measures Study Report-Plant 2: Attachment S1B Focused Corrective Measure Study OA-11*. October.

U.S. Environmental Protection Agency. 1997. *Draft Standard Operating Procedure for Sampling Concrete in the Field*. Prepared by Region I, EPA-New England, Office of Environmental Measurement and Evaluation. 30 December.

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ATTACHMENTS

Table 1	Proposed Soil Sampling Scheme
Table 2	Sample Handling Criteria
Table 3	Data Quality Objectives
Figure 1	Remediation Areas for South Plant 2 and OA-11
Figure 2	OA-11 Proposed Limits of Excavation and Stormwater Features
Figure 3	Total PCBs in Soil and Proposed Soil Boring Locations
Figure 4	Proposed Soil and Groundwater Sample Locations
Attachment 1	Field Verification of Area of Discovery Boundary
Attachment 2	Standard Guidelines for Field Procedures
Attachment 3	Health and Safety Plan

Tables

Table 1
Proposed Soil Sampling Scheme[1, 2, 3, 4]

Proposed Soil Boring / Sample Interval (feet bgs)	OA11-DP01	OA11-DP02	OA11-DP03	OA11-DP04	OA11-DP05	OA11-DP06	OA11-DP07	OA11-DP08	OA11-DP09	OA11-DP10	OA11-DP11	OA11-DP12	OA11-DP13	OA11-DP14	OA11-DP15	OA11-DP16	OA11-DP17	OA11-DP18
0–1																		
1–2																		
2–3			TPH and PCBs	TPH and PCBs	PCBs	PCBs	PCBs	PCBs	PCBs	PCBs	PCBs	TPH and PCBs						
3–4																		
4–5	TCE		TCE, Archive	Archive	Archive	Archive	Archive	Archive	Archive	Archive	Archive	Archive	TPH and PCBs	TPH and PCBs	TPH and PCBs	TPH and PCBs	TPH and PCBs	TPH and PCBs
5–6																		
6–7			TPH and PCBs	TPH and PCBs	PCBs	PCBs	PCBs	PCBs	PCBs	PCBs	PCBs	TPH and PCBs	TPH and PCBs	TPH and PCBs	TPH and PCBs	TPH and PCBs	TPH and PCBs	TPH and PCBs
7–8																		
8–9	TPH, PCBs, and TCE	TPH, PCBs, and TCE	TPH, PCBs, and TCE	TPH, PCBs, and TCE	PCBs	PCBs	PCBs	PCBs	PCBs	PCBs	PCBs	TPH and PCBs	TPH and PCBs	TPH and PCBs	TPH and PCBs	TPH and PCBs	TPH and PCBs	TPH and PCBs
9–10																		
10–11	TPH and PCBs	TPH, PCBs, and TCE	Archive	Archive	Archive	Archive	Archive	Archive	Archive	Archive	Archive	Archive						
11–12																		
12–13	TPH and PCBs	TPH and PCBs																TPH and PCBs
13–14																		
14–15	TPH and PCBs	Archive											TPH and PCBs	TPH and PCBs	TPH and PCBs	TPH and PCBs	TPH and PCBs	

Notes:

1 Analysis:

TPH analysis will be by the NWTPH-Dx method, quantified for diesel, heavy-oil, and mineral spirit/Stoddard solvent ranges.

PCB analysis will be for Aroclors (summed as total) by USEPA Method 8082, consistent with the draft *Corrective Measures Study for Plant 2* .

TCE samples will be collected using USEPA Method 5035 and analyzed by USEPA Method 8260C.

2 TPH and PCB samples are presented in the sample intervals where they should be collected (i.e., 8 to 10 feet bgs).

3 TCE samples will be collected using a core sampler from a discrete sample depth within the designated interval.

4 Archive samples will be collected and held at the laboratory for potential future analysis of TPH or PCBs, pending the results of initial sampling.

Abbreviations:

bgs Below ground surface
PCB Polychlorinated biphenyl
TCE Trichloroethene
TPH Total petroleum hydrocarbons

Table 2
Sample Handling Criteria

Parameter	Analysis Method	Sample Container and Preservation	Preservation	Holding Time
Soil Samples				
Polychlorinated Biphenyls — Aroclor	USEPA Method 8082	One 8-oz clear glass jar	Unpreserved, cool to ≤6°C	1 year
Total Petroleum Hydrocarbons—Diesel-, Heavy Oil-, and Stoddard Solvent Ranges with Silica Gel Cleanup	NWTPH-Dx	One 8-oz clear glass jar	Unpreserved, cool to ≤6°C	14 days to extract, then 40 days to analyze
Chlorinated Volatile Organic Compounds	USEPA Method 8260C	Three 40-mL glass VOA vials with PTFE septum	One vial with methanol preservative, two vials with sodium bisulfate preservative, cool to ≤6°C	14 days to analyze
Concrete Samples				
Polychlorinated Biphenyls — Aroclor	USEPA Method 8082	One 4-oz clear glass jar	Unpreserved, cool to ≤6°C	1 year
Groundwater Samples				
Chlorinated Volatile Organic Compounds	USEPA Method 8260C	Three 40-mL glass VOA vials with PTFE septum[1]	HCl preservative, cool to ≤6°C	14 days to analyze

Note:
1 No head space in sample container.

Abbreviations:
°C Degrees Celsius
HCl Hydrochloric acid
mL Milliliter
oz Ounce
PTFE Polytetrafluoroethylene
USEPA United States Environmental Protection Agency
VOA Volatile organic analysis

Table 3
Data Quality Objectives

Parameter	Decision Criteria	Analysis Method	Detection Limit[1]	Reporting Limit[2] (PQL or LOQ)	Precision (Relative Percent Difference)	Accuracy (Percent Difference from Standard)	Completeness (Percentage of Data Validated)
Soil Samples							
Polychlorinated Biphenyls —Aroclor	1,000 µg/kg 10,000 µg/kg 50,000 µg/kg	USEPA Method 8082	8.0 µg/kg	20 µg/kg	± 30%	± 50%	95%
Total Petroleum Hydrocarbons—Diesel-, Heavy Oil-, and Stoddard Solvent Ranges with Silica Gel Cleanup	17,000 mg/kg	NWTPH-Dx	Diesel: 2.34 mg/kg Oil: 2.99 mg/kg Stoddard: 2.34 mg/kg	Diesel: 5.0 mg/kg Oil: 10 mg/kg Stoddard: 5.0 mg/kg	± 30%	± 50%	95%
Chlorinated Volatile Organic Compounds (cVOCs)[3]	30 µg/kg 20,000 µg/kg	USEPA Method 8260C	0.2–0.7 µg/kg	1 µg/kg	± 20%	± 50%	95%
Concrete Samples							
Polychlorinated Biphenyls —Aroclor	50,000 µg/kg	USEPA Method 8082 [4]	8.0–9.3 µg/kg or 38–73 µg/kg [5]	20 µg/kg or 800 ug/kg	± 30%	± 50%	95%
Groundwater Samples							
Chlorinated Volatile Organic Compounds[3]	1.4 µg/L	USEPA Method 8260C	0.03 µg/L	0.2 µg/L	± 30%	± 60%	95%

Notes:

1 Method detection limit varies by analyte; range is presented.
2 All reporting limits shown are method PQLs or LOQs provided by Analytical Resources Inc., located in Tukwila, Washington.
3 For the purpose of this investigation, cVOCs means the chlorinated ethenes: trichloroethene (TCE), the three dichloroethene isomers (DCE isomers), and vinyl chloride.
4 Laboratory analysis of concrete samples by USEPA Method 8082 will be completed with extraction methods suitable to ensure complete extraction from the sample (e.g., Microwave).
5 Detection limits may be elevated relative to those presented here if concrete contains high levels of PCBs or cannot be crushed to a fine powder for analysis; however, in no case is it expected that the detection limit would be elevated greater than decision criteria associated with the data and described in the Work Plan.

Abbreviations:

LOQ Limit of quantitation
µg/kg Micrograms per kilogram
µg/L Micrograms per liter
mg/kg Milligrams per kilogram
PQL Practical Quantitation Limit
USEPA U.S. Environmental Protection Agency

Figures

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Additional Characterization for OA-11 Interim Measure
Boeing Plant 2
Seattle/Tukwila, Washington

Figure 1
Remediation Areas for South Plant 2 and OA-11

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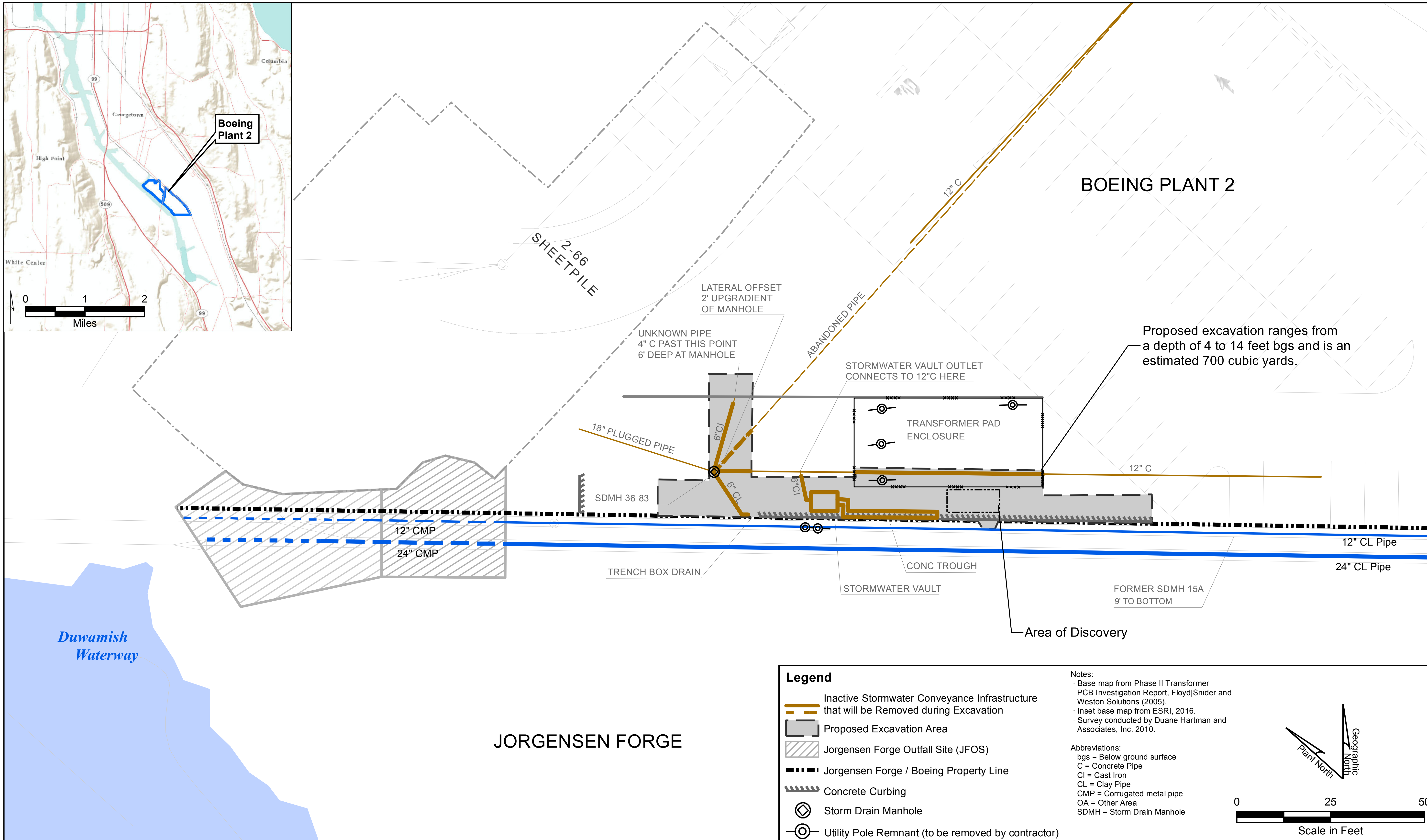

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Additional Characterization for OA-11 Interim Measure
Boeing Plant 2
Seattle/Tukwila, Washington

Figure 2
OA-11 Proposed Limits of Excavation and Stormwater Features

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Legend

Total PCB Concentrations in Soil in mg/kg

- Detected Concentration ≤ 1.0 mg/kg
- Detected Concentration between 1.0 and 10 mg/kg
- Detected Concentration >10 mg/kg
- PCBs Analyzed for, but Not Detected

Sample Interval Depth:

- 0–2 ft bgs
- 2–5 ft bgs
- 5–10 ft bgs
- 10–20 ft bgs

Proposed Excavation Depth in ft bgs:

- 4 ft
- 8 ft
- 12 ft
- 14 ft

- 2-66 Sheetpile (AMEC, April 2011)
- Jorgensen Forge Outfall Site (JFOS)
- Cleanup Level Demarcation Lines (February 2012)
- Jorgensen Forge / Boeing Property Line

- Additional Characterization– Additional characterization will determine if excavation is necessary, including whether the excavation depth is sufficient and whether it includes infrastructure removal.
- Area of Discovery– Additional data are necessary to determine vertical and horizontal lines of excavation.
- Proposed Soil Boring

Notes:
- Total PCBs data sourced from 2011 JFOS Investigation and existing Golder Boeing Plant 2 Database.
- Hybrid orthoimagery provided by ESRI (2011) and David C. Smith and Associates, Inc. (July 2011)

Abbreviations:
bgs = Below ground surface
CMP = Corrugated metal pipe
ft = Feet
LAT = Lateral pipe
mg/kg = Milligrams per kilogram
OA = Other Area
PCB = Polychlorinated biphenyl
ppm = parts per million
RA = Remediation Area
SCL = Seattle City Light

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Additional Characterization for OA-11 Interim Measure
Boeing Plant 2
Seattle/Tukwila, Washington

Figure 3
Total PCBs in Soil and Proposed Soil Boring Locations

I:\GIS\Projects\BOE-PL2\MXD\Additional Characterization EPA Memo\Figure 3 Total PCBs in Soil and Proposed Soil Boring Locations_V2.mxd
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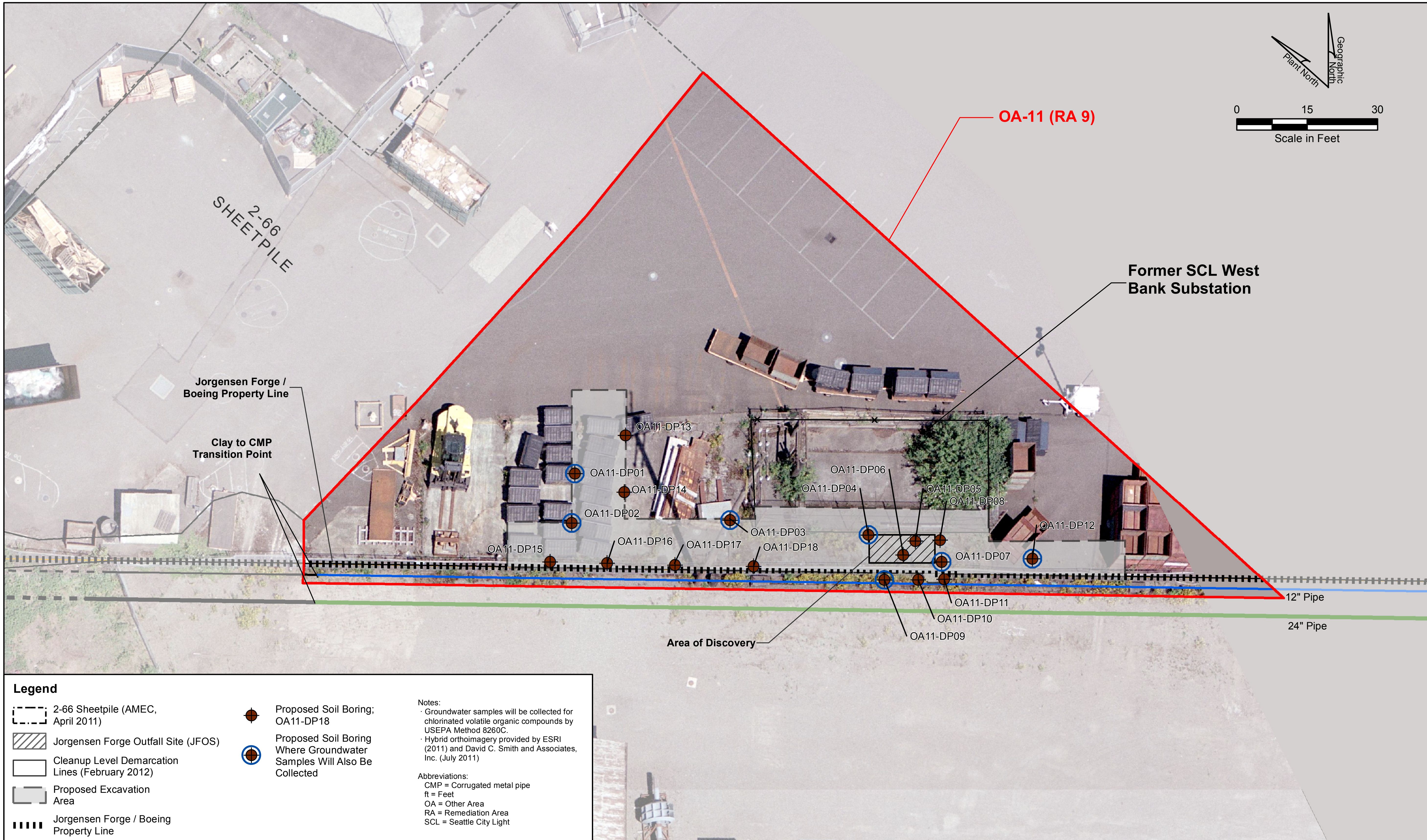

Legend

- 2-66 Sheetpile (AMEC, April 2011)
- Jorgensen Forge Outfall Site (JFOS)
- Cleanup Level Demarcation Lines (February 2012)
- Proposed Excavation Area
- Jorgensen Forge / Boeing Property Line
- Proposed Soil Boring; OA11-DP18
- Proposed Soil Boring Where Groundwater Samples Will Also Be Collected

Notes:
- Groundwater samples will be collected for chlorinated volatile organic compounds by USEPA Method 8260C.
- Hybrid orthoimagery provided by ESRI (2011) and David C. Smith and Associates, Inc. (July 2011)

Abbreviations:
CMP = Corrugated metal pipe
ft = Feet
OA = Other Area
RA = Remediation Area
SCL = Seattle City Light

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Additional Characterization for OA-11 Interim Measure
Boeing Plant 2
Seattle/Tukwila, Washington

Figure 4
Proposed Soil and Groundwater Sample Locations

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6/8/2016

Attachment 1
Field Verification of Area of Discovery Boundary

Attachment 1
Field Verification of Area of Discovery Boundary

The Boeing Company (Boeing) is conducting an Uplands Corrective Measures Study (CMS) at Boeing Plant 2 pursuant to the Administrative Order on Consent (Order; Resource Conservation and Recovery Act [RCRA] Docket No. 1092-01-22-3008(h)) issued to Boeing in 1994 by the U.S. Environmental Protection Agency (USEPA) under authority of RCRA Section 3008(h), as amended (42 USC 6928(h)). As outlined in the CMS, Plant 2 has been divided into nine Remediation Areas (RAs) based on the nature and extent of contamination greater than proposed Final Media Cleanup Levels. RA 9 contains the area known as Other Area 11 (OA-11), which includes the former fenced Seattle City Light (SCL) West Bank Substation (Substation). Figure 1 depicts key features of OA-11 (RA 9) discussed herein. A Draft Focused Corrective Measure Study (FCMS) for OA-11 was submitted to USEPA in October 2014 as Attachment S1B of the Draft Uplands Corrective Measure Study Volume X (CMS) for Plant 2 (EPI, et al. 2014). The corrective measure for OA-11, which primarily consists of excavation of polychlorinated biphenyl- (PCB-) impacted soil, is now being conducted as an interim measure jointly with the Toxics Substances Control Act (TSCA) program under a Risk-Based Disposal Approval (RBDA). To accelerate completion of the OA-11 cleanup, the draft FCMS was revised as a draft Interim Measure Work Plan.

Contamination adjacent to the Substation was discovered in August 2001 during a curbing installation project. As part of curb installation activities, Boeing removed pavement, a portion of a concrete trough, and incidental soil. Soil located beneath a removed section of concrete had a distinct hydrocarbon odor; analytical soil sample results indicated that high levels of PCBs were present. Boeing excavated approximately 7 cubic yards of soil in this area in an excavation approximately 6 feet wide by 10 feet long by 3 feet deep to remove contaminated soil and to further define the extent of PCBs (Exhibit A, Photograph 1). While a significant mass of contamination was removed in the initial excavation, residual contamination was left behind. Sidewall and bottom samples revealed variable PCB concentrations ranging from less than laboratory method detection limits to 660 parts per million (ppm). Boeing notified USEPA and the Washington State Department of Ecology (Ecology) of the discovery and excavation, and the area was backfilled and paved to prevent human contact and stormwater infiltration. The area of initial excavation and sampling was termed the “Area of Discovery.”

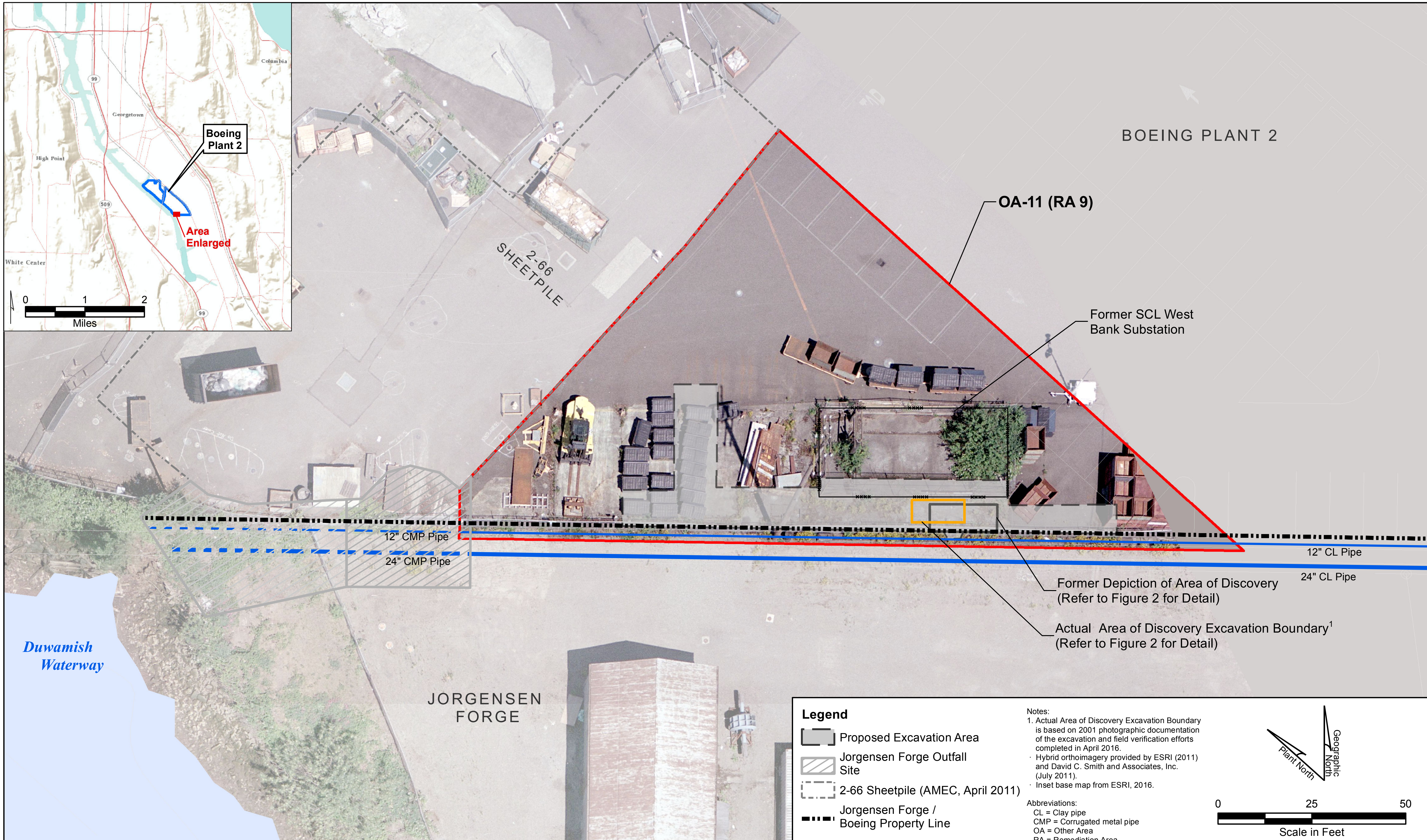
The Area of Discovery has been variably depicted on many site figures over the past 15 years, and work in preparation for the OA-11 interim measure raised a concern that it has been incorrectly shown as being about 10 feet east of its actual location and having various areal extents. The Area of Discovery was never surveyed; instead, it was defined using field-measurements referenced off of the Transformer Pad, which is located within the Substation. Graphics produced following the discovery of the release incorrectly referenced the western extent of the PCB release to the edge of the Substation, rather than to the edge of the Transformer Pad. This discrepancy was confirmed during field verification conducted as part of planning for the OA-11 interim measure excavation project. The true understanding of the Area of Discovery excavation area and the former depiction of the Area of Discovery are both shown on Figure 2 relative to identifying features in the vicinity of the Substation. Photograph 1 of Exhibit A provides historical evidence that the edge of the excavation should have been referenced to the edge of the Transformer Pad.

Soil with PCB contamination greater than a threshold concentration of 50 ppm requires special treatment under the TSCA program. Field verification was completed in April 2016 to mark out planned soil boring locations relative to existing data to establish the limits of the PCB contamination greater than 50 ppm, and, accordingly, to mark-out the proposed excavation limits. Photographs 2 through 5 of Exhibit A were taken during the recent field verification efforts and also show that the replaced concrete associated with the 2001 excavation is visually distinct from the older concrete, further confirming the reference point error. Locations of sidewall and bottom samples collected during the 2001 excavation have also been located to reflect the true geographic extent of the Area of Discovery.

While the geographic location of the Area of Discovery and associated excavation confirmation soil sample locations have shifted from those depicted in prior documents, the nature and extent of the proposed excavation described in the draft OA-11 Interim Measure Work Plan are not affected, as both the current and former boundaries of the Area of Discovery are contained entirely within the proposed limits of excavation.

ENCLOSURES

Figure 1	Features in OA-11 in the Vicinity of the Area of Discovery
Figure 2	Detail View of Area of Discovery Boundaries
Exhibit A	Photographs 1 through 5



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Field Verification of Area of Discovery Boundary
Boeing Plant 2
Seattle/Tukwila, Washington

Figure 1
Features in OA-11 in the Vicinity of the Area of Discovery

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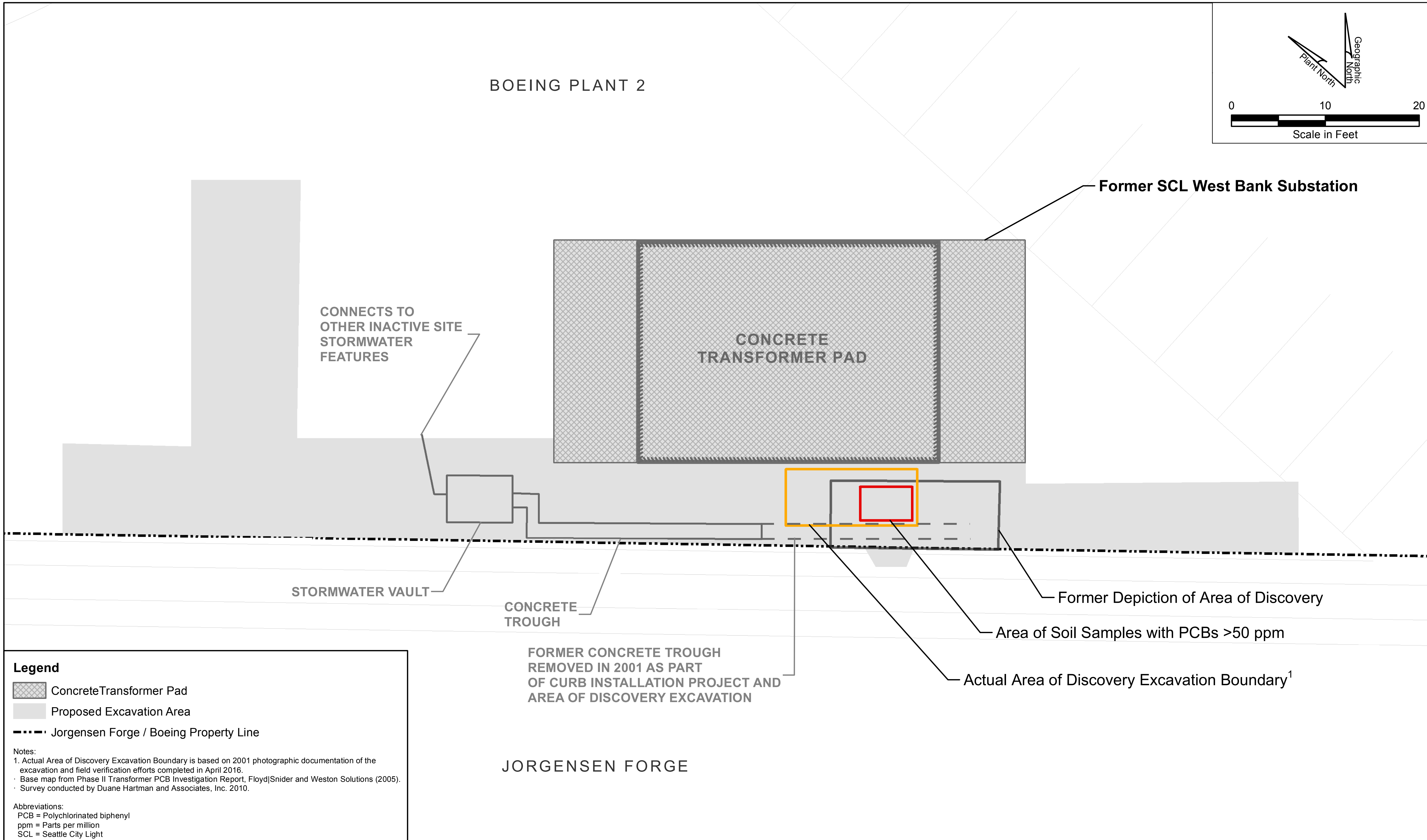
5/20/2016



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Field Verification of Area of Discovery Boundary
Boeing Plant 2
Seattle/Tukwila, Washington

Figure 2
Detail View of Area of Discovery Boundaries

Photograph 1. Area of Discovery excavation; taken on December 13, 2001, looking east.

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Photograph 2. Photograph of the Area of Discovery taken facing east during field verification efforts in April 2016. Dotted line indicates approximate eastern boundary of 2001 excavation.

Photograph 3. Photograph of the Area of Discovery taken facing west during field verification efforts in April 2016. Dotted line indicates approximate western boundary of 2001 excavation.

FLOYD | SNIDER strategy ▪ science ▪ engineering	**Field Verification of Area of Discovery Boundary** **Boeing Plant 2** **Seattle/Tukwila, Washington**	Exhibit A Photographs 2 and 3

Photograph 4. Photograph of the Area of Discovery taken facing east during field verification efforts in April 2016. Dotted line indicates approximate boundary of 2001 excavation.

Photograph 5. Photograph of the Area of Discovery taken facing west during field verification efforts in April 2016. Dotted lines indicate approximate eastern and western boundaries of 2001 excavation.

FLOYD | SNIDER strategy ▪ science ▪ engineering	**Field Verification of Area of Discovery Boundary** **Boeing Plant 2** **Seattle/Tukwila, Washington**	Exhibit A Photographs 4 and 5

Attachment 2
Standard Guidelines for Field Procedures

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F|S STANDARD GUIDELINE

Soil Sample Collection

DATE/LAST UPDATE: May 2015

These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field, but are not intended to be step by step procedures, as some steps may not be applicable to all projects.

All field staff should be sufficiently trained in the standard guidelines for the sampling method they intend to use and should review and understand these procedures prior to going into the field. It is the responsibility of the field staff to review the standard guidelines with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines.

1.0 Scope and Purpose

This standard guideline presents commonly used procedures for collection of soil samples for characterization and laboratory analysis. The methods presented in this guideline apply to the collection of soil samples during the following characterization activities: soil borings via drilling, manual collection of shallow soil samples, test pit excavation, excavation confirmation, and stockpile characterization. Specific details regarding the collection of discrete and composite samples, and special sampling techniques for volatile organic compounds (VOCs) are also included. The guideline is intended to be used by staff who collect soil samples in the field.

It is important that the field staff completing the soil sample collection discusses the specific needs for a particular investigation with the project geologist, the project manager, or whoever will ultimately be responsible for interpreting the findings of the field investigation. This discussion is in addition to field training and general knowledge about soil sampling, and should happen prior to entering the field, with additional follow-up before finalizing the field forms, after the investigation is complete.

2.0 Equipment and Supplies

Soil Sampling Equipment and Tools:

- Tape measure or measuring wheel
- Stainless steel bowls and spoons
- Graduated plunger and collection tubes for VOC samples (if needed)
- Trash bags
- Decontamination tools including:
    - Paper towels
    - Spray bottles of alconox (or similar) solution
    - Deionized or distilled water
- Adhesive drum labels, or paint or grease pen
- Washington State Department of Transportation- (WSDOT) approved drums for investigation-derived waste (IDW) disposal, if needed (if drilling, to be provided by driller)
- Camera
- Hand-held global position system (GPS; optional)
- Coolers, sample jars, labels, ice

Paperwork:

- Work Plan and/or Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP)
- Health and Safety Plan (HASP)
- Sample collection forms printed in Rite in the Rain paper, or Rite in the Rain field notebook

Personal Equipment:

- Steel-toed boots
- Safety vest
- Safety glasses
- Nitrile gloves
- Rain gear
- Work gloves

3.0 Standard Procedures

3.1 OFFICE PREPARATION

Prior to going into the field, review the SAP/QAPP tables to become familiar with the desired sample intervals, nomenclature, field Quality Assurance (QA) samples, analytes, sample containers, and holding times for each analytical method.

At least one week prior to sampling, coordinate with the laboratory specified in the SAP/QAPP to get coolers and appropriate sample containers. Familiarize yourself with the volume requirements and container types, preservation methods, and holding times for each class of analytes.

3.2 GENERAL SOIL SAMPLE COLLECTION PROCEDURES

1. Locate the desired sample location and depth interval using a handheld GPS or by taking field measurements from known site features. Note the soil type and any other observations or indications of contamination on a soil boring log, soil sample collection form or field notebook, as described in the Soil Logging Standard Guideline. Note the location and depth of the sample and take a photograph, if possible.
2. Refer to subsections 3.2.1 through 3.2.4 for the appropriate soil collection procedures for drilling, shallow soil, test pit excavation, excavation confirmation, and stockpiles. If collecting samples for VOC analysis by the U.S. Environmental Protection Agency (USEPA) Method 5035, refer to Section 3.3 for specific sample collection procedures for this method. If composite soil sampling is recommended, refer to Section 3.4 for details.
3. Once soil has been collected from the desired depth or interval, mix thoroughly until the sample is homogenous in color, texture, and moisture.
4. Fill the required laboratory-provided jars, taking care not to overfill. If large gravels (diameter greater than ~ 1 inch) are encountered, these should be discarded to ensure that an adequate soil volume is collected for analysis. If necessary, use a clean paper towel to remove soil particles from the threaded mouth of the jar before securing lids to ensure a good seal.
5. Label each jar with the sample name, date, time, field staff initials and required analyses. If collecting a field duplicate, use the sample nomenclature specified in the work plan and note the field duplicate name and sample time in the sample log. If extra volume for matrix spike/matrix spike duplicate (MS/MSD) analysis is being collected, use the same name on all jars. Soil samples should be protected from moisture by placing the filled sample jars into separate sealed Ziploc bags before placing them into a cooler.

6. Complete a chain-of-custody form for all samples, including sample names, date and time of collection, number of containers, and required analyses and methods. Keep samples on ice to maintain temperatures of 4-6 degrees Celsius (°C) and transport to the laboratory under chain-of-custody procedures.

3.2.1 Soil Sample Collection via Drilling

These procedures should be used for drilling via direct-push, hollow stem auger, or roto-sonic methods where a pre-designated sample interval (i.e. 0 to 5 feet below ground surface [bgs]) is retrieved from the subsurface using a split spoon sampling device, lined core, or bag sampler.

1. Ensure that reusable sampling equipment has been thoroughly decontaminated prior to sampling.
2. Use a stainless steel spoon or trowel, or disposable scoop to remove an equal volume of soil across the targeted depth interval from the sampler.
   a. If using a split spoon sampler or other reusable sampler, avoid collecting the soil that is touching the sides of the sampler to the extent practical.
   b. If the soil touching a reusable sampler must be collected to obtain adequate volume for analysis, notify the PM and record in the field logbook.

3.2.2 Manual Collection of Shallow Soil Samples

These procedures should be used for shallow soil sampling via scoop, trowel, shovel, or hand auger.

1. Dig or auger to the bottom depth of the shallowest sample to be collected, using a tool that has been cleaned and decontaminated. Verify that the target depth has been reached using a measuring tape.
2. If using a scoop or trowel, collect the soil directly into a decontaminated stainless steel bowl.
3. If using a shovel, the soil may either be collected in bowls or set as aside on plastic sheeting in favor of collecting the sample from the sidewall of the hole. If sampling the sidewall, use a decontaminated or disposable scoop or trowel to collect soil from the target depth, or scrape along the sidewall to collect soil across a target depth interval. Transfer soil to a decontaminated stainless steel bowl, repeating until a sufficient volume has been collected.
4. If using a hand auger, empty the cylinder of the auger directly into a decontaminated stainless steel bowl. It may be necessary to empty the hand auger onto plastic sheeting or into a bowl in order to reach the target depth without overflowing the sampler.
5. Any soil from depth intervals that are not targeted for sampling should be set aside on plastic sheeting and returned to the hole after sampling.

3.2.3 Sample Collection from Test Pits or Limited Soil Excavations

These procedures should be used for collecting samples from test pit explorations excavated using a back hoe or excavator. These same general procedures should also be followed for post-excavation soil samples used to confirm that an excavation has removed contaminated material or to document post-excavation conditions after target excavation limits have been reached.

1. Measure the length, width, and depth of the test pit or excavation area to verify that the target extents have been reached. The lateral spacing of the test pit or excavation confirmation samples, or exact location of samples should be specified in the work plan and typically depend on the size of the excavation area but can vary significantly from project to project.
2. If not specified in the work plan, sidewall samples may be collected either midway between the ground surface and base of the excavation, or incrementally along the entire height of the sidewall. Both sidewall and base (bottom) samples should penetrate a minimum of 6 inches beyond the excavated surface.
3. If the test pit or excavation is less than 4 feet deep, or has been benched to accommodate safe entry, a sample may be collected directly from the sidewall(s). To collect soil from a sidewall, use a decontaminated or disposable scoop, trowel, or shovel to obtain soil from the desired depth or depth interval directly into a decontaminated stainless steel bowl.
4. If a test pit or excavation cannot be safely entered, instruct the excavator operator to scoop sidewall material from the target depth or depth interval. Collect the soil sample from the excavator bucket using a decontaminated stainless steel spoon, trowel, or disposal scoop, avoiding material that has come into contact with the teeth or sides of the bucket. Place an adequate volume of soil into a decontaminated stainless steel bowl. If necessary, follow the compositing procedures in Section 3.4.

3.2.4 Stockpile Sampling

These procedures should be used for classifying stockpiled soil, including excavated soil and imported backfill material.

1. Where potentially contaminated soils have been previously excavated and stockpiled on site, Washington State Department of Ecology (Ecology) guidance recommends using a decontaminated or disposable scoop or trowel, penetrating 6 to 12 inches beneath the surface of the pile at several locations until sufficient volume for analysis is achieved. A decontaminated shovel may also be used to facilitate collection of soil from large piles. The locations for soil collection should be where contamination is most likely to be present based on field screening (i.e. staining, odor, sheen, or elevated photoionization detector [PID] readings). If there are not field indications of contamination, the locations should be distributed evenly around the stockpile.

2. The stockpile may need to be broken up into sections for sample collection depending on the size of the pile (i.e., segregate the pile in half or quarters). If this is necessary, it is important to document where each set of samples were collected from (i.e., north quadrant) and create a field sketch of the pile for reference.
3. If a sampling frequency is not specified in the work plan, the general rule of thumb for contaminated soil stockpile profiling is to collect and submit 3 analytical samples (these samples can be multi-point composites or grabs) for stockpiles less than 100 cubic yards (CY), 5 samples for stockpiles between 100 and 500 CY, 7 samples for stockpiles 500 to 1,000 CY, 10 samples for stockpiles 1,000 to 2,000 CY, and 10 samples for stockpiles larger than 2,000 CY with an additional sample collected for every 500 CY of material. This rule of thumb is consistent with Ecology guidance for site remediation.
4. Samples for characterization of stockpiles of imported backfill or other presumed clean material should also be collected as described above. If not described in the work plan, the typical sample frequency for imported or clean material characterization is one sample per 500 CY.

3.3 SOIL SAMPLE COLLECTION FOR VOC ANALYSIS

If collecting soil samples for VOC analysis by USEPA Method 5035, collect these samples first before disturbing the soil. This method uses a soil volume gauge fitted with a disposable soil sampling plunger tube to collect a soil plug that can be discharged directly to a VOA vial, limiting the loss of volatiles during sampling. The collection of VOC samples using the 5035 method specifies use of an airtight VOA vial with a septum lid. Ecology’s interpretation of the USEPA 5035 method allows for field preservation of the sample with methanol or sodium bisulfate, or laboratory preservation (i.e. field collection into an un-preserved vial). It is important to note that if laboratory preservation is the selected method, samples must be received at the laboratory within 48-hours of sample collection. The method of sample preservation for the 5035 method will vary for each site and is dependent on site-specific conditions. Preservation method selection should be coordinated with the laboratory and specified in the sampling plan.

1. Note the volume of soil needed for analysis as specified by the laboratory (commonly 5 or 10 grams). Raise the handle of the soil volume gauge to the slot in the gauge body corresponding to the desired volume and turn clockwise until the tabs in the handle lock into the slot.
2. Insert a sample tube at the open end of the gauge body and turn clockwise until the tabs on the tube lock into the “0 gram” slot. Remove the cap from the sample tube and press directly (where possible) into the shallow soil, soil core/sampler, excavation base or sidewall, or stockpile.
3. Continue pressing the sample tube until the plunger is stopped by the sample volume gauge. If a depth interval (for example 9 to10 feet) is targeted for VOC sampling, collect small volumes of soil across this interval until the sample tube is filled

4. Twist counterclockwise to disengage the sample tube, then depress the plunger to eject the soil plug directly into a laboratory-provided VOA vial. If multiple vials per sample are required, the same plunger may be re-used to fill the remaining vials.

3.4 COMPOSITE SAMPLE COLLECTION

For this guideline, composites are considered to be samples that are collected across more than one location, or multiple depth intervals at a single location. Samples collected over continuous depth intervals within a sampling device (i.e. split spoon) are addressed for each sampling method in Section 3.2 above.

Compositing of sample material may be performed in the field, or by the analytical laboratory. To collect a field composite sample, identify the locations and depth(s) that will comprise the composite. Collect soil from the first target sub-sample depth or depth interval and hold in a decontaminated stainless steel bowl, covered with aluminum foil to prevent cross contamination and label with the location and depth. Continue to collect and hold individual sub-samples until all components of the composite have been collected, then transfer an equal amount of each sub-sample to a clean bowl and homogenize. Fill necessary sample jars from homogenized composite. In some cases, project plans may require that each individual sample that comprised the composite be collected in jars and submitted to the laboratory in the event that individual sample analysis is desired, or if laboratory compositing is requested in addition to field compositing as a field quality control measure. In this case, label each individual jar, but indicate HOLD on the chain-of-custody, and note that the sample is part of composite XYZ.

To collect a laboratory composite sample, collect, and label each sub-sample using the procedures described above in Section 3.2. Record each sub-sample on the chain-of-custody form, and indicate on this form which samples should be composited by the laboratory and the desired name of the composite sample. It is important to communicate to the laboratory if discrete samples will also require analysis (in some cases) or only the composite sample.

4.0 Decontamination

All reusable equipment that comes into contact with soil should be decontaminated prior to moving to the next sampling location.

Stainless steel bowls and spoons, and any tools used for sample processing will be decontaminated between each sample; alternatively, disposable bowls and spoons may be used. Equipment decontamination will consist of a tap water rinse to remove soil particles, followed by scrubbing with brushes and an alconox (or other soap)/clean water solution and a final rinse with distilled or deionized water.

5.0 Investigation-Derived Waste

Unless otherwise specified in the project work plan, waste soils will be contained, transported, disposed of in accordance with applicable laws, and stored in a designated area until transported off-site for disposal.

The approach to handling and disposal of these materials is as follows. For IDW that is containerized, such as waste soils, 55-gallon drums approved by WSDOT will be used for temporary storage pending profiling and disposal. Each container holding IDW will be sealed and labeled as to its contents (e.g., “soil”), the dates on which the wastes were placed in the container, the owner’s name and contact information for the field person who generated the waste, and the site name.

IDW that is placed into drums for temporary storage will be characterized relative to applicable waste criteria using data from the sampling locations whenever possible. Material that is designated for off-site disposal will be transported to an off-site facility permitted to accept the waste. Manifests will be used, as appropriate for disposal.

Disposable sampling materials and incidental trash such as paper towels and personal protective equipment (PPE) used in sample processing will be placed in heavy duty garbage bags or other appropriate containers and disposed of as solid waste in the municipal collection system (i.e., site Dumpster).

6.0 Field Documentation

All observations including sample collection locations, soil descriptions, sample depths, collection times, analyses, and field QC samples should be recorded on a boring log, soil sample collection form, or bound field notebook. Information recorded should additionally include personnel present (including subcontractors), purpose of field event, weather conditions, sample collection date and times, sample analytes, and any deviations from the SAP.

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F|S STANDARD GUIDELINE

Soil Logging

DATE/LAST UPDATE: May 2015

These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field, but are not intended to be step by step procedures, as some steps may not be applicable to all projects.

All field staff should be sufficiently trained in the standard guidelines and should review and understand these procedures prior to going in the field. It is the responsibility of the field staff to review the standard guidelines with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines.

1.0 Scope and Purpose

These soil logging standard guidelines should be used by the field staff performing subsurface investigations, such as a direct push or roto-sonic soil boring, installation of a monitoring well via hollow stem auger, or roto-sonic or mud rotary drilling. While many projects will not necessarily have a Licensed Geologist (LG) or Hydrogeologist (LHG) who reviews and stamps every boring log, it is important that the field staff discusses the soil logging needs for a particular investigation with the project geologist, the project manager, or whoever will ultimately be responsible for interpreting the findings of the field investigation. This discussion is in addition to field training and general knowledge about soil logging, and should happen prior to entering the field, with additional follow-up before drafting a final set of electronic logs, after the investigation is complete.

2.0 Equipment and Supplies

Logging Equipment and Tools:

- 100-foot tape measure or measuring wheel
- Handheld Global Positioning System (GPS; optional)
- Unified Soil Classification System (USCS) Soil Classification Field Guide

- Soil logging kit containing:
  - Stainless steel spoons
  - Paint scraper or trowel
  - Small Ziploc bags
  - Small stainless steel bowls or black mining pans for sheen testing
  - Spray bottle filled with water
  - Paper towels (preferably white)
  - Engineers tape
  - Note cards
  - Optional items include:
    - Empty VOA vials or small glass jars
    - Munsell color chart
    - Sieves
    - White and grayscale color cards for photographs
- Plastic sheeting and duct tape or clamps to cover the sampling table
- Camera
- Trash bags
- Coolers
- Jars
- Labels
- Ice

Paperwork:

- Work Plan and/or Sampling and Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP)
- Health and Safety Plan (HASP)
- Copies of figures showing previous boring locations and boring logs from previous investigations, if available
- Boring log forms appropriate for drilling method, printed in Rite in the Rain paper and/or bound field notebook
- Permanent markers and pencils

Personal Equipment:

- Steel-toed boots
- Hard hat

- Safety vest
- Safety glasses
- Nitrile gloves
- Ear plugs
- Rain gear
- Work gloves

3.0 Standard Procedures

3.1 OFFICE PREPARATION

First, meet with the project manager or field manager to identify the key information and goals of the soil boring investigation. These may include fill history, known or suspected sources of contamination and potential field indications of these contaminants, identification of specific units, or important geotechnical measurements. If possible, select a boring log template that is appropriate for the project needs.

Next, review the work plan and all available existing materials such as cross-sections or boring logs from previous investigations to familiarize yourself with the site geology. In addition (or alternatively if other information is not available), you may also review a geologic map of the area from a reputable source such as United States Geological Survey (USGS).

Finally, check the area of the site where drilling will occur for underground objects. At minimum, a OneCall locate request should be made at least one week in advance of drilling in order to give public utility locators time to mark known buried utility lines. All planned boring locations should be marked on the ground with white spray paint prior to making a locate request. In almost all cases, a private utility locator should also clear the area of drilling any underground objects using electromagnetic techniques. If drilling is to occur in close proximity to buried utilities, the work plan may specify use of an air knife or vacuum to clear the borehole to a depth below the utility lines.

3.2 COLLECTING SOIL SAMPLES FOR CLASSIFICATION

1. Before beginning drilling, record the following information on each log:
   a. Operator's name and company, equipment make/model, equipment measurements (i.e., sampler length and diameter, hammer weight and stroke if using hollow stem auger, boring diameter)
   b. Your name, date, project, boring name and approximate descriptive location (i.e., where is the soil boring relative to known site features). Include a description of the ground surface and whether or not coring was necessary, if coring was necessary, include core diameter, concrete thickness, and subcontractor information.

    c. A small hand drawn map showing your location with measurements to a stationary reference point, or GPS coordinates (ideally, both). This is also a good place to note if you have had to move a boring location because of underground utilities, access issues, etc. It is important to note the reason for relocation and the direction and distance moved (i.e., moved 10 feet to the north due to presence of subsurface water line).

2. If you are using a hollow stem auger drilling method, it is important to communicate to the driller how often you would like a split spoon sample collected. Typically this would be continuous or every 5 feet but may be different depending on the project needs.
3. Note any feedback from the driller about the drilling conditions. This may include difficult drilling or rig chatter (usually caused by hard materials), heaving sands (usually caused by hydrostatic pressure on the borehole), caving, or hole instability.
4. For split spoon samples, record the number of hammer blows (blow counts) necessary to drive the sampler each 6-inch increment, as reported by the driller. If more than 50 blows are needed, record the distance that the sampler was driven in 50 blows (i.e., 2-inches in 50 blows). This is referred to as the standard penetration test.
5. Cover the sampling table with plastic sheeting. Lay an engineer's tape lengthwise across the sampling table. Once a sample has been collected, orient it on the table so that the top is aligned with the 0-foot mark on the tape.
6. Split open the sampler, core barrel liner, or sample collection bag. Record the depth interval that the sampler was driven and the depth interval of soil that was recovered. For split spoons or single-cased core barrels, such as Geoprobe direct-push rods, determine whether any loose 'slough' soil has been dislodged by the drilling equipment and deposited at the top of your core (AMS direct push rods are double cased and do not create slough). Do not include slough in the measurement of the soil recovered. Often the core will be filled with an uninterrupted column of soil that is shorter in length than the total drive interval. In such cases, record the recovery interval as it is situated in the core unless you are able to determine the actual depth where the soil sample originated.
7. Before further disturbing the soil, take volatile organic compound (VOC) measurements with a photoionization detector (PID), if using. Take measurements by making crevices in the soil with a spoon or scraper and inserting the PID probe into these openings. Alternatively, collect small spoonfuls of soil into Ziploc bag(s), seal the bag(s), gently shake the bag(s), and insert the PID probe through the top of the bag(s) and into the headspace once the soil vapor has been allowed to equilibrate with the surrounding air (headspace method). The bag headspace screening method is typically more accurate and is useful at sites with low concentrations of VOCs, whereas the in-situ method is a faster and more qualitative method, best used at sites with higher VOC concentrations. If sampling for VOCs by the U.S. Environmental Protection Agency (USEPA) Method 5035, these soil samples should also be collected

prior to disturbing the core. Soil sampling procedures using USEPA Method 5035 are described in detail in the Soil Sample Collection Standard Guideline.

8. Use a straight edge to scrape the soil level and expose the center of the core. Photograph the core alongside the measuring tape and an index card displaying the soil boring location/ID and depth interval.

3.3 SOIL CLASSIFICATION

Soils are described using the following characteristics: Moisture content, color, consistency, MAJOR CONSTITUENT, minor constituent, geotechnical properties, other observations (e.g. visual or olfactory indications of contamination). The USCS field guide is included in this guidance for reference. The steps below should help guide the logger in classifying soils according to the USCS.

1. Note the moisture content of the soil, using “dry,” “moist,” “wet,” or “saturated.” Mark the water table at the time of drilling on the log at the depth where saturated soil is first observed
2. Record the color of the soil. A descriptive color (i.e., light brown) or a color identified using the Munsell color chart are both valid.
3. Determine whether organic matter influences the properties of the material. If so, record as an organic soil.
4. If the soil is predominantly inorganic, identify whether the major constituent is coarse- or fine-grained. Coarse-grained soils include sands and gravels; fine-grained soils include silts and clays.
   a. For coarse grained soils, determine:
      i. Grain size(s) present including fine, medium, or coarse, and grain size distribution including well-graded (a mixture of fine to coarse grains) or poorly-graded (uniform in size). The USCS guide is helpful for determining grain sizes. If the major constituent is gravel, note its angularity using “rounded,” “sub-angular” or “angular.”
      ii. Minor constituent(s). If a minor constituent represents less than approximately 15% of the sample, note this as “with [minor constituent]” and optionally, whether it is “trace” (<5%) or “few” (5-15%). If a minor constituent represents more than 15% of the sample, use “[minor constituent]-y.” For example, a sand with 5% silt would be classified as a “SAND with trace silt” and sand with 30% silt would be classified as a “SILTY SAND.” For coarse-grained soils with fines between 5% and 15%, the USCS includes several dashed classifications, such as SW-SM. It is often helpful to record an estimated percentage for soil constituents to aid in classification according to the USCS.

b. For fine-grained soils, determine:

i. Major constituent. To determine whether a material is silt or clay, a simple settling test may be performed in a glass vial or gloved hand by spraying a small amount of the sample with water. Silt particles will settle out of suspension in water within a few minutes, whereas clay particles will remain suspended for a longer period of time.

ii. Minor constituent(s). As described above, determine the approximate percentage and record as "with [minor constituent]" or "[minor constituent]-y" as appropriate. It is often helpful to record an estimated percentage to aid in classification according to the USCS.

iii. Geotechnical properties. Depending on project data needs, geotechnical properties may be optional but often provide helpful information. Geotechnical properties include plasticity (ranging from "non-plastic" to "highly plastic" as determined by a thread test) and consistency (ranging from "loose" to "very dense" for coarse-grained soils and "soft" to "hard" for fine-grained soils). When using split spoon samplers, blow counts recorded during the standard penetration test (also referred to as N-values) are used to determine consistency; when using direct-push or sonic drilling, consistency is described qualitatively.

5. Using the USCS guide and the description of the soil, determine the appropriate USCS symbol and record it on the log. If it is difficult to distinguish the major constituent of a soil, a borderline "/" symbol may be used to denote the two potential major constituents present. This is not the same as the USCS classifications that utilize a dash, such as SW-SM.

6. Determine whether contacts between stratigraphic units are abrupt, or gradational. Note abrupt contacts using a solid line and gradational contacts using a dotted line. If the contact between units is not visible and was missed between sample depths, a dashed line is used.

7. If the site or area geology is known, and you are confident in your identification of a specific stratum, note the geologic unit. At a site where the geology is uncertain, you may make some more general notes about the depositional environment, such as identifying probable estuarine deposits, colluvium, glacial till, etc.

3.4 OTHER OBSERVATIONS

1. Record other materials observed in the sample. These may include minor amounts of rootlets or other plant matter, evidence of organisms such as shell fragments, and/or anthropogenic debris such as brick fragments, plastic, or metal debris.

2. Record potential indications of contamination. These may include odors, colored or black staining on soils, colored crystals, hydrocarbon sheens, or non-aqueous phase liquid (NAPL) product.
    a. To test for hydrocarbon sheen, put a small amount of soil in a bowl, saturate with water and swirl, noting whether a rainbow sheen appears on the surface of the water. Alternatively, place a small amount of water in the bottom of the bowl and a small amount of soil along the side, then tilt the bowl so that the water slowly touches the soil. If observed, note the color of the sheen and describe as slight (discontinuous on the water surface), moderate (continuous but spreading slowly) or high (rainbow sheen covering entire surface water).
    b. To test for the presence of NAPL, use a clean paper towel to blot the surface of the core and note the proportion of the towel that is saturated with oil (be sure to allow the towel to dry when blotting moist to wet soils to distinguish between saturation due to NAPL and due to water).
3. Note the final depth of the boring and any reasons for early termination of the boring (i.e., refusal).
4. If monitoring wells will be installed, follow the Standard Guidelines for monitoring well construction and well development.

4.0 Decontamination

All reusable equipment that comes into contact with soil should be decontaminated as follows prior to moving to the next sampling location.

Split spoons, stainless steel bowls and spoons, and any other tools used for soil classification must be decontaminated between boring locations. If collecting soil samples for chemical analysis, split spoons and any tools used for sample processing must be decontaminated between each sample; alternatively, disposable bowls and spoons may be used. Equipment decontamination will consist of a tap water rinse to remove soil particles, followed by scrubbing with brushes and an alconox (or similar)/clean water solution and a final rinse with distilled or deionized water.

5.0 Investigation-Derived Waste

Unless otherwise specified in the project work plan, waste soils and other drilling materials generated during soil boring activities will be contained, transported, disposed of in accordance with applicable laws, and stored in a designated area until transported off-site for disposal.

The approach to handling and disposal of these materials is as follows. For investigation-derived waste (IDW) that is contained, such as waste soils, 55-gallon drums approved by the Washington State Department of Transportation (WSDOT) will be supplied by the driller and used for temporary storage pending profiling and disposal. Each container holding IDW will be sealed and labeled as to its contents (e.g., “soil cuttings”), the dates on which the wastes were placed in the container, the owner's name, contact information for the field person who generated the waste, and the site name.

Whenever possible, IDW contained within drums will be characterized relative to applicable waste criteria using data from the sampling locations. Material that is designated for off-site disposal will be transported to an off-site facility that is permitted to accept the waste. Manifests will be used as appropriate for disposal.

Disposable sampling materials and incidental trash such as paper towels and personal protective equipment (PPE) used in sample processing will be placed in heavy duty garbage bags or other appropriate containers and disposed of as solid waste in the municipal collection system (i.e., site dumpster).

6.0 Field Documentation

All observations should be recorded on a soil boring form appropriate for the drilling method or in a bound field notebook. Field staff should make an effort to record as much detail as possible in the field log. After the field work is complete, a set of final logs (usually electronic) that serve as the record for the project will be completed in consultation with the project manager or field manager.

Enclosure: USCS Soil Classification Field Guide

FIELD GUIDE FOR SOIL AND STRATIGRAPHIC ANALYSIS v.2

midwest GEOSCIENCES group
www.midwestgeo.com

START HERE

DENSITY OR CONSISTENCY

COARSE GRAINED DEPOSITS N-VALUE	
0-4	► VERY LOOSE
5-10	► LOOSE
11-29	► MEDIUM DENSE
30-49	► DENSE
>50	► VERY DENSE

FINE GRAINED DEPOSITS N-VALUE	q_u (tsf)	
0-2	<0.25	► VERY SOFT
3-4	0.25-0.50	► SOFT
5-8	0.50-1.0	► MEDIUM
9-15	1.0-2.0	► STIFF
16-30	2.0-4.0	► VERY STIFF
>30	>4.0	► HARD

COLOR
Use Standard Munsell Color Notation

IS THE COLOR A MATRIX COLOR?
- YES → MATRIX COLOR: List in sequence, dominant first
- NO → IS THE COLOR FROM A COATING OR CONCENTRATION?
  - YES → COATING or CONCENTRATION: Note frequency, color, and size
  - NO → MOTTLE: Note contrast, color, and size

CLASSIFICATION
Unified Soil Classification System - adopted ASTM D2488

STEP 1: IS SEDIMENT COARSE GRAINED OR FINE GRAINED?

COARSE-GRAINED DEPOSITS (>50% coarse-grained sediments, <50% fines)

STEP 2: DETERMINE SAND VS. GRAVEL RATIO

I N C R E A S I N G G R A I N S I Z E

SAND: FINE | MEDIUM | COARSE — GRAVEL: SMALL | LARGE

0.075 MM · 0.425 MM · 2.0 MM · 4.75 MM · 19.0 MM · 75.0 MM

STEP 3: CONTINUE WITH SAND OR GRAVEL ON FLOW CHART (REVERSE)

FINE-GRAINED DEPOSITS (organic and inorganic) (>50% fines, <50% coarse-grained sediments)

STEP 2: DETERMINE PLASTICITY AND ASSIGN USCS GROUP SYMBOL

I N C R E A S I N G P L A S T I C I T Y

NON PLASTIC | LOW PLASTICITY | MEDIUM PLASTICITY | HIGH PLASTICITY

ML | CL | CH

STEP 3: CONTINUE WITH GROUP SYMBOL ON FLOW CHART (REVERSE)

MOISTURE

- MOISTURE ABSENT ► DRY
- DAMP ► MOIST
- VISIBLE WATER ► WET

FOR NON-PLASTIC FINES
- WATER RISES TO SURFACE SLOWLY ► SLOW DILATENCY
- WATER RISES TO SURFACE QUICKLY ► RAPID DILATENCY

PLASTICITY
(Use with CLASSIFICATION)

- WILL NOT SUPPORT 6mm DIAMETER ROLL IF HELD ON END ► NON-PLASTIC
- 6mm DIA. ROLL CAN BE REPEATEDLY ROLLED AND SUPPORTS ITSELF, 4mm DIA. ROLL DOES NOT ► LOW PLASTICITY
- 4mm DIA. ROLL CAN BE REPEATEDLY ROLLED AND SUPPORTS ITSELF, 2mm DIA. ROLL DOES NOT ► MEDIUM PLASTICITY
- 2mm DIA. ROLL CAN BE REPEATEDLY ROLLED AND SUPPORTS ITSELF ► HIGH PLASTICITY

6mm · 4 · 2

COHESIVENESS

- 6mm DIAMETER ROLL CANNOT BE FORMED ► NONCOHESIVE
- 6mm DIAMETER ROLL CAN BE FORMED ► COHESIVE

SEDIMENTARY STRUCTURE

- UNIFORM ► MASSIVE
- BEDS >30cm ► THICKLY BEDDED
- BEDS 3cm to 30cm ► BEDDED
- BEDS 0.5cm to 3cm ► THINLY BEDDED
- BEDS <0.5cm ► LAMINATED

SECONDARY SOIL STRUCTURE (IN SOLUM ONLY)
- Spheroidal peds or granules usually packed loosely ► GRANULAR
- Irregular, roughly cubelike peds with planar faces (angular or subangular) ► BLOCKY
- Flat and horizontal peds ► PLATY
- Vertical, pillarlike peds with flat tops ► PRISMATIC
- Vertical, pillarlike peds with curved tops (which are commonly "bleached") ► COLUMNAR

WEATHERING ZONE ABBREVIATION

MODIFIER SYMBOL (if present)	1st SYMBOL	2nd SYMBOL	LAST SYMBOL (if present)
MOTTLED ► M	OXIDIZED ► O	LEACHED ► L	SECONDARY CARBONATE ► 2
JOINTED ► J	REDUCED ► R	UNLEACHED ► U	
	UNOXIDIZED ► U		

EXAMPLE: solum, OJL, MOJL, MOJL2, MOJU — MRJU, RJU, RU, UU

SECONDARY GRAIN SIZE INFORMATION

- < 5% ► TRACE
- 6% to 15% ► LITTLE
- 16% to 30% ► FEW
- 31% to 49% ► SOME

- ► UNIFORM (poorly graded)
- ► NON-UNIFORM (well graded)

- ► FINE SAND
- ► MEDIUM-GRAINED SAND
- ► COARSE-GRAINED SAND
- ► FINE GRAVEL
- ► COARSE GRAVEL

FOR GLACIAL DIAMICTONS ► CLAST FRACTION ► CLAST LITHOLOGY

DEPOSITIONAL ENVIRONMENT

VARIOUS DEPOSITIONAL ENVIRONMENTS (interpretation)
- ► EOLIAN (LOESS)
- ► FLUVIAL
- ► ALLUVIAL
- ► LACUSTRINE
- ► COASTAL
- ► RESEDIMENTED

GLACIAL DEPOSITIONAL PROCESSES
- ► SUBGLACIAL
- ► GLACIOFLUVIAL
- ► GLACIOLACUSTRINE
- ► RESEDIMENTED

GENERALIZED RESEDIMENTATION PROCESSES
- ► MASS SLUMP
- ► SEDIMENT FLOW
- ► COLLUVIUM

STRATIGRAPHIC NAME

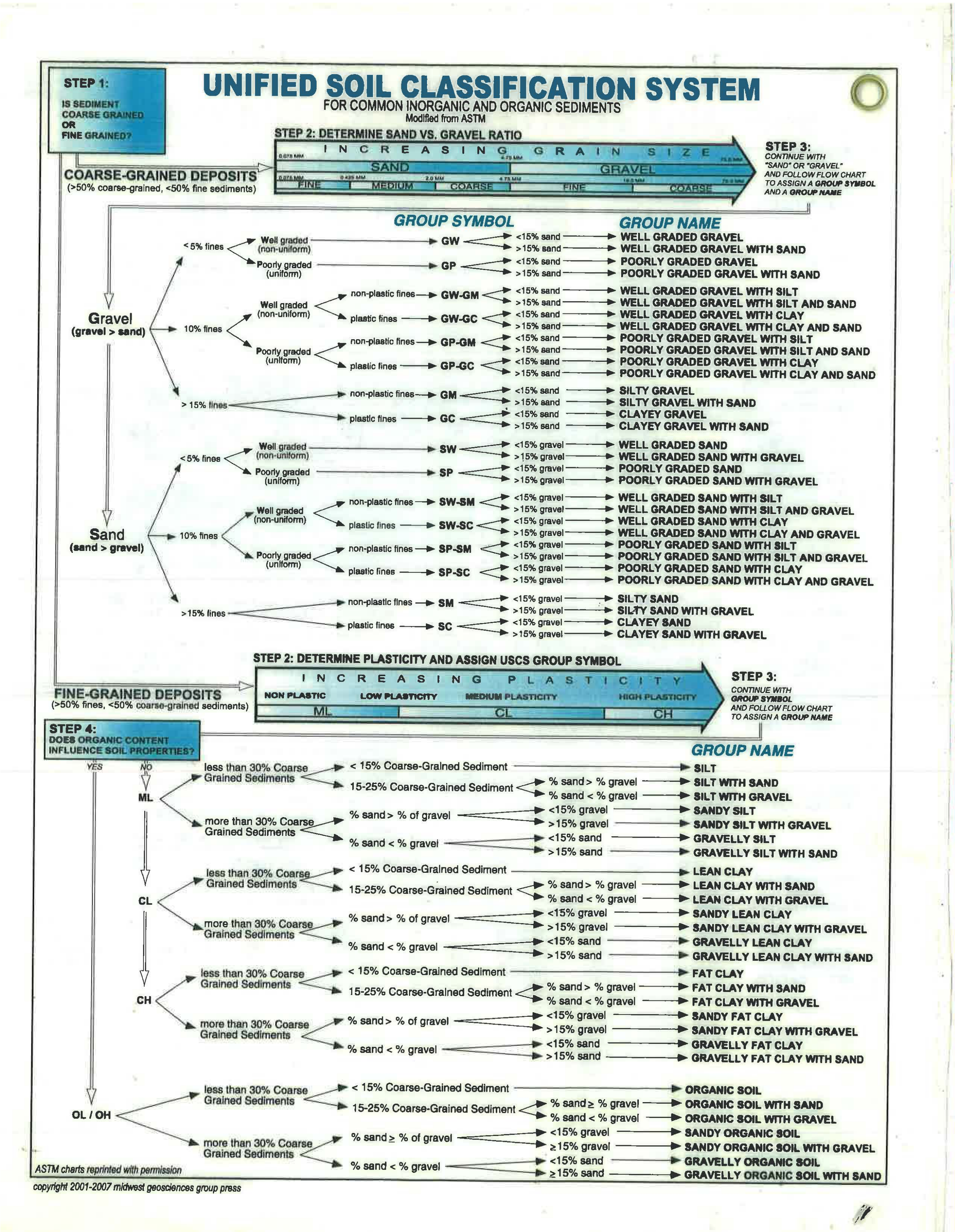
USE FORMAL STATE GEOLOGICAL SURVEY NOMENCLATURE WHEN POSSIBLE;
IF NOT POSSIBLE, ASSIGN SITE-SPECIFIC UNIT NAME ACCORDING TO DEPOSITIONAL ENVIRONMENT / FACIES ASSEMBLAGE

STRATIGRAPHIC CONTACT

- < 10 cm ► SHARP (or ABRUPT for pedogenic alternation)
- > 10 cm (Note transition interval) ► GRADATIONAL (or TRANSITIONAL for weathering zone change)

010106

USCS SOIL CLASSIFICATION FIELD GUIDE



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F|S STANDARD GUIDELINE

Groundwater Sample Collection with a Direct-Push (i.e., Geoprobe) Drill Rig

DATE/LAST UPDATE: September 2015

These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field, but are not intended to be step-by-step procedures, as some steps may not be applicable to all projects.

All field staff should be sufficiently trained in the standard guidelines for the sampling method they intend to use and should review and understand these procedures prior to going into the field. It is the responsibility of the field staff to review the standard guidelines with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines.

1.0 Scope and Purpose

This standard guideline provides details necessary for collecting representative groundwater samples using a direct-push drill rig. These guidelines are designed to meet or exceed guidelines set forth by the Washington State Department of Ecology (Ecology).

2.0 Equipment and Supplies

Groundwater Sampling Equipment and Tools:

- Peristaltic pump and battery (typically provided by driller; confirm prior to mobilization)
- Water level meter
- Multi-parameter water quality meter (if applicable)
- Polyethylene tubing, Teflon tubing, or similar
- MasterFlex (silicone) tubing
- Filters (if field filtering)

- Tube cutters, razor blade, or scissors
- 55-gallon drum and clamp (or 5-gallon drum) and labels
- 5-gallon bucket
- Paper towels
- Alconox (or similar decontamination solution)
- Distilled or deionized water
- Spray bottles
- Trash bags

Lab Equipment:

- Sample jars/various types of pre-cleaned bottles (as applicable)
- Coolers
- Chain-of-Custody Forms
- Labels
- Ice
- Ziploc bags

Paperwork:

- Field notebook with site maps and previous boring logs, if available
- Sampling forms
- Purge water plan
- Rite-in-the-Rain pens, paper, and permanent markers
- Site-Specific Health and Safety Plan (HASP)
- Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP), or other similar work plan

Personal Protective Equipment (PPE):

- Steel-toed boots
- Safety vest
- Hard hat
- Nitrile gloves
- Safety glasses

- Rain gear
- Work gloves

3.0 Standard Procedures

The following sections describe the procedure for sampling groundwater using direct-push methods. Before entering the field, project considerations including the target aquifer or depth for sampling and screen placement (i.e., across or within the water table) should be discussed with the Project Manager. Any deviations from these procedures should be approved by the Project Manager and fully documented. Groundwater sampling from a direct-push boring consists of purging and sampling water within the borehole with a peristaltic pump. Direct-push drilling activities will typically follow Floyd|Snider Standard Guidelines for Soil Sampling.

3.1 CALIBRATION OF WATER QUALITY METERS

Water quality meters used during groundwater sampling (if applicable) will be calibrated prior to each sampling event. Calibration procedures are outlined in each instrument's specific user manual.

3.2 PURGING AND SAMPLING PROCEDURES

Once the direct-push drilling activities have reached the desired depth, a new polyvinyl chloride (PVC) or decontaminated stainless steel casing and screen is temporarily installed in the borehole by the driller. Record the depth-to-water and total depth of the well to calculate the volume (this is calculated by multiplying the area inside the casing by the height of water in the casing). Slowly lower new polyethylene or Teflon tubing down the temporary casing and use a peristaltic pump to purge and collect groundwater samples. The discharge line should be directed to a 55-gallon drum (or 5-gallon drum or bucket), provided by the drilling subcontractor to contain the purge water generated. Purging will continue until the groundwater is visually clear (if achievable) or at least 3 well volumes have been removed.

After the well has been purged and the sample bottles have been labeled, the groundwater sample will be collected by directly filling the laboratory-provided bottles from the pump discharge line. All sample containers should be filled with minimum disturbance by allowing the water to flow down the inside of the bottle or vial. When collecting a volatile organic compound (VOC) sample, fill to the top to form a meniscus over the mouth of the vial prior to placing the cap in order to eliminate air bubbles. Do not overfill preserved sample jars or pre-cleaned Volatile Organic Analyte (VOA) sampling vials.

If sampling for dissolved analytes (such as metals), collect these samples last and with attention to the flow direction arrow, fit an in-line filter at the end of the discharge line. A minimum of 0.5 to 1 liter of groundwater must pass through the filter prior to collecting the sample.

Sample labels will clearly identify the project name, sampler's initials, sample location and unique sample ID, analysis to be performed, date, and time. Upon collection, samples will be placed in a cooler maintained at a temperature of approximately 4 to 6 degrees Celsius (°C) using ice. Chain-of-Custody Forms will be completed. Upon transfer of the samples to the laboratory, the Chain-of-Custody Form will be signed by the persons transferring custody of the sample containers to document change in possession.

When sample collection is completed at a designated location, remove and properly dispose of the tubing and temporary well screen and casing. In most cases, this waste is considered solid waste and can be disposed of as refuse.

4.0 Decontamination

Prior to moving to the next sampling location, all reusable equipment that has come into contact with groundwater should be decontaminated using the processes described in this section.

Water Level Meter: The water level indicator and tape will be decontaminated between direct-push sampling locations and at the end the day by spraying the entire length of tape that came in contact with groundwater with an Alconox (or similar)/water mixture followed by a thorough rinse with distilled or deionized water.

Water quality sensors and flow-through cell (if used): Use distilled or deionized water to rinse the water quality sensors and flow-through cell. No other decontamination procedures are recommended since the equipment is sensitive. After the sampling event, the water quality meters will be cleaned and maintained according to the specific manual.

Submersible Pump: Decontaminating the pump requires running the pump in three progressively cleaner grades of water.

1. Fill a bucket with approximately 4 gallons or more to sufficiently cover the pump of an Alconox (or similar)/clean water solution. Place the pump and the length of the power cord (if applicable) that was in contact with water into the bucket and run the pump for approximately two minutes or until the volume of water in the bucket has been exhausted.
2. Fill a second bucket containing approximately 4 gallons or more to sufficiently cover the pump of clean water. Place the pump and cord into this bucket and run the pump for approximately two minutes or until the volume of water in the bucket has been exhausted.
3. Fill a third bucket with approximately 4 gallons or more to sufficiently cover the pump of distilled or deionized water. Place the pump and cord into this bucket and run the pump for approximately two minutes or until the volume of water in the bucket has been exhausted.

The Alconox/water solution may be re-used; however rinse water should be collected for disposal as described in Section 5.0 below. When done for the day, dry the exterior of the pump and cord with clean towels to the extent practical prior to storage: all decontaminated water (including Alconox solution) should be managed in accordance with Section 5.0 below.

All reusable equipment on the drill rig (such as casings and rods) that comes into contact with soil or groundwater will be decontaminated by the driller between locations. The drilling subcontractor will store all decontaminated water in labeled 55-gallon drums on-site for proper disposal unless otherwise specified.

5.0 Investigation-Derived Waste (IDW)

Unless otherwise specified in the project-specific work plan, water generated during groundwater sampling activities will be contained and stored in a designated area until it can be transported and disposed of off-site in accordance with applicable laws.

The approach to handling and disposal of these materials for a typical cleanup site is as follows.

For IDW that is containerized, (such as purge water), 55-gallon drums (or other smaller sized drums) approved by the Washington State Department of Transportation will be used for temporary storage pending profiling and disposal. Each container holding IDW will be sealed and labeled as to its contents (e.g., “purge water”), the dates on which the wastes were placed in the container, the owner’s name, contact information for the field person who generated the waste, and the site name.

IDW containerized within drums will be characterized relative to applicable waste criteria using data from the sampling locations whenever possible. Material that is designated for off-site disposal will be transported to an off-site facility permitted to accept the waste. Manifests will be used, as appropriate, for disposal.

Disposable sampling materials and incidental trash such as paper towels and PPE used in sample processing will be placed in heavy-duty garbage bags or other appropriate containers and disposed of as trash in the municipal collection system.

6.0 Field Documentation

Drilling and groundwater sampling activities will be documented in field sampling forms and/or notebooks and Chain-of-Custody Forms. Information recorded will at a minimum include personnel present (including subcontractors), purpose of field event, weather conditions, sample collection date and times, sample analytes, depths to water, water quality field measurements (if collected), amount of purged water generated, and any deviations from the SAP.

Attachment 3
Health and Safety Plan

Boeing Plant 2
OA-11

Health and Safety Plan

Prepared for

The Boeing Company
Seattle, Washington

June 2016

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LIMITATIONS

This report has been prepared for the exclusive use of The Boeing Company, their authorized agents, and regulatory agencies. It has been prepared following the described methods and information available at the time of the work. No other party should use this report for any purpose other than that originally intended, unless Floyd|Snider agrees in advance to such reliance in writing. The information contained herein should not be utilized for any purpose or project except the one originally intended. Under no circumstances shall this document be altered, updated, or revised without written authorization of Floyd|Snider.

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List of Appendices

List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
° F	Degrees Fahrenheit
Boeing	The Boeing Company
COC	Contaminant of concern
EZ/CRZ	Exclusion zone/contamination reduction zone
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operation and Emergency Response
HSO	Health and Safety Officer
OA-11	OA-11/RA9 area of Boeing Plant 2 (also referred to as the Site)
OSHA	Occupational Safety and Health Act
PCB	Polychlorinated biphenyl
PID	Photoionization detector
PM	Project Manager
PPE	Personal protective equipment
SS	Site Supervisor
SSO	Site Safety Officer
SZ	Support zone
TCE	Trichloroethene
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation

1.0 Plan Objectives and Applicability

This Health and Safety Plan (HASP) has been written to comply with the standards prescribed by the Occupational Safety and Health Act (OSHA) and the Washington Industrial Safety and Health Act (WISHA).

The purpose of this HASP is to establish protection standards and mandatory safe practices and procedures for all personnel involved with investigation activities related to installation of soil borings, soil and groundwater sampling, and stormwater system concrete sampling in the OA-11/RA9 area of Boeing Plant 2 (OA-11, also referred to as the Site). This HASP assigns responsibilities, establishes standard operating procedures, and provides for contingencies that may occur during field work activities. The scope of field activities is described in detail in the *Technical Memorandum Work Plan for Additional Characterization for OA-11 Interim Measure* and is presented as an attachment to the Work Plan. This plan consists of site descriptions, a summary of work activities, an identification and evaluation of chemical and physical hazards, monitoring procedures, personnel responsibilities, a description of site zones, decontamination and disposal practices, emergency procedures, and administrative requirements.

The provisions and procedures outlined by this HASP apply to all Floyd|Snider personnel on-site. Subcontractors performing work activities that are not substantially different from the scope of work described above may follow the provisions and procedures of the Floyd|Snider HASP, with separate task- or equipment-specific health and safety protocols provided as necessary. Contractors, subcontractors, other oversight personnel, and all other persons involved with the field work activities, other than those described herein, are required to develop and comply with their own HASPs. All staff conducting field activities under this HASP are required to read the HASP and indicate that they understand its contents by signing the Health and Safety Officer/Site Supervisors' (HSO/SS') copy of this plan.

It should be noted that this HASP is based on information that was available as of the date indicated on the title page. It is possible that additional hazards that are not specifically addressed by this HASP may exist at the work site, or may be created as a result of on-site activities. It is the firm belief of Floyd|Snider that active participation in health and safety procedures and acute awareness of on-site conditions by all workers is crucial to the health and safety of everyone involved. Should project personnel identify a site condition that is not addressed by this HASP and have any questions or concerns about site conditions, they should immediately notify the HSO/SS and The Boeing Company's (Boeing's) Onsite Activity Representative.

The HSO/SS has field responsibility for ensuring that the provisions outlined herein adequately protect worker health and safety and that the procedures outlined by this HASP are properly implemented. In this capacity, the HSO/SS will conduct regular site inspections to ensure that this HASP remains current with potentially changing site conditions. The HSO/SS has the authority to make health and safety decisions that may not be specifically outlined in this HASP, in consultation with the Boeing Onsite Activity Representative, should site conditions warrant such actions. In the event that the HSO/SS leaves the Site while work is in progress, an alternate Site

Safety Officer (SSO) will be designated. Personnel responsibilities are further described in Section 4.0.

This HASP has been reviewed by the Project Manager (PM) and the HSO/SS prior to commencement of work activities. All Floyd|Snider personnel shall review the plan and be familiar with on-site health and safety procedures. A copy of the HASP will be on-site at all times.

2.0 Emergency Contacts and Information

2.1 DIAL EMERGENCY SERVICES

In the event of any emergency, dial the Boeing emergency number (206) 655-2222 to reach fire, police, and first aid.

2.2 HOSPITAL AND POISON CONTROL

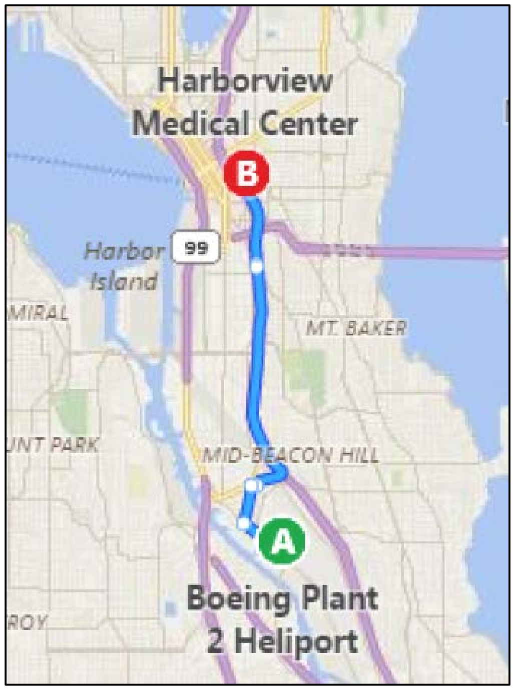
Nearest Hospital Location and Telephone: Refer to Figure 2.1 below for map and directions to the hospital.	Harborview Medical Center 325 9th Avenue Seattle, WA 98104 (206) 731-3000
Washington Poison Control Center:	(800) 222-1222

2.3 PROVIDE INFORMATION TO EMERGENCY PERSONNEL

All Floyd|Snider project personnel should be prepared to give the following information:

Information to Give to Emergency Personnel	
Site Location:	Refer to the building number and door number of the structure closest to your location.
Number that You are Calling from:	This information is provided on the phone you are calling from.
Type of Accident or Type(s) of Injuries:	Describe accident and/or incident or injury and numbers of personnel needing assistance.

Figure 2.1
Hospital Directions



1. Head toward Site Entrance at EAST MARGINAL WAY SOUTH
2. Turn LEFT on EAST MARGINAL WAY SOUTH
3. Turn RIGHT on CORSON AVENUE SOUTH
4. Turn RIGHT on SOUTH BAILEY STREET
5. Use the left 2 lanes to turn LEFT onto INTERSTATE 5 N RAMP
6. Take EXIT 164A and continue onto JAMES STREET
7. Turn RIGHT onto JAMES STREET
8. Turn RIGHT onto 9th AVENUE
9. Turn RIGHT onto JEFFERSON STREET
10. JEFFERSON STREET turns slightly left and becomes 8th AVENUE
11. Hospital entrance is on the RIGHT

2.4 FLOYD|SNIDER AND PORT OF SEATTLE EMERGENCY CONTACTS

After contacting emergency response crews as necessary, contact the Floyd|Snider Project Manager, or a Principal, to report the emergency. The Floyd|Snider Contact may then contact Boeing personnel, or direct the field staff to do so.

Floyd|Snider Emergency Contacts:

Contact	Office Phone Number	Cell Phone Number
Lynn Grochala, Project Manager	(206) 292-2078	(603)491-3952
Teri Floyd, Principal		(206) 713-1329
Tom Colligan		206-276-8527

The Boeing Company Emergency Contacts:

Contact	Office Phone Number	Cell Phone Number
Boeing Company Emergency Number	(206) 655-2222	
Jennifer Parsons	(206) 715-7918	(206) 715-7918
Will Ernst	(206) 655-4949	(425) 891-7724

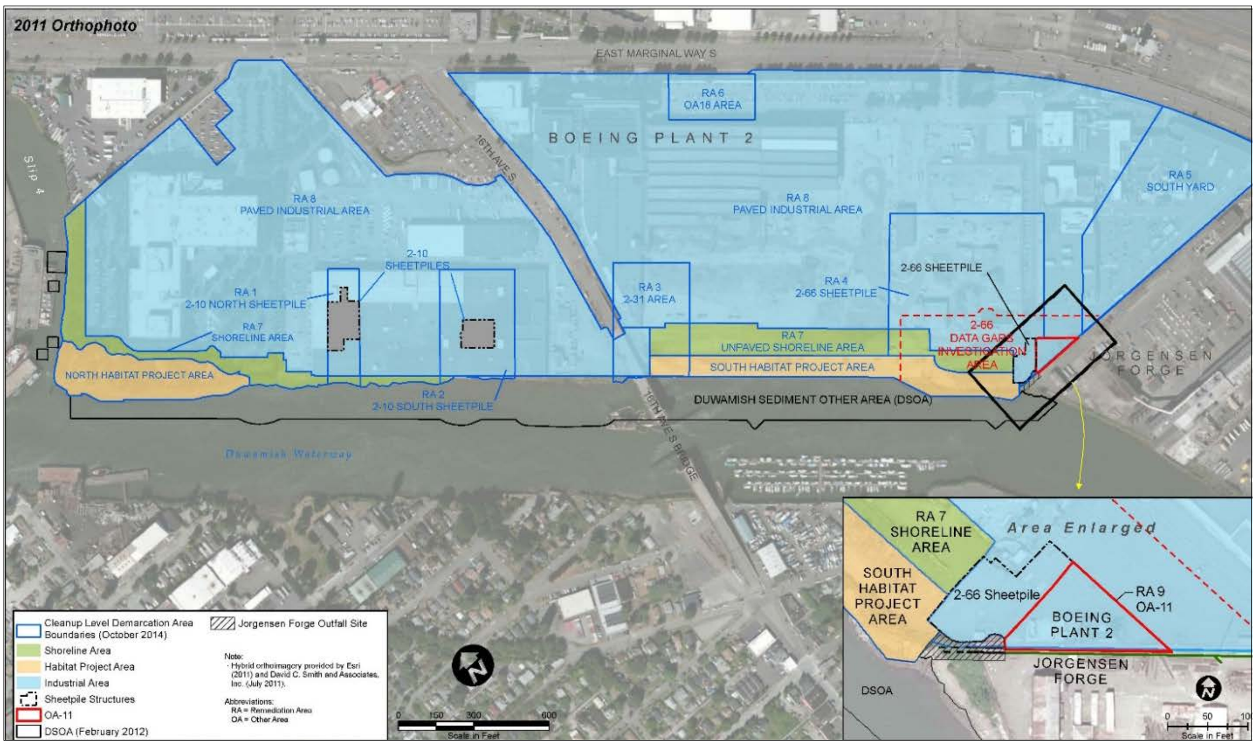
In addition to the Boeing Company Emergency Contacts listed above, a Boeing-provided Safety Dash Card should be kept on the dashboard of the field vehicle while on-site. The Safety Dash Card provides additional details regarding emergency and non-emergency contacts at Boeing and alternative hospital driving directions. The Safety Dash Card is provided in Appendix A.

3.0 Background Information

3.1 SITE BACKGROUND

Floyd|Snider will conduct field investigation and data collection activities at Boeing Plant 2 on behalf of Boeing at 7755 East Marginal Way South in Seattle, Washington. OA-11 is a paved area located at the southeast corner of the Boeing Plant 2 property (refer to Figure 3.1).

Figure 3.1
OA-11 Location



Previous investigations at OA-11 have identified an area of polychlorinated biphenyl- (PCB-) and total petroleum hydrocarbon- (TPH-) impacted soil, which will be excavated during the Summer 2016 construction season. The field investigation and data collection activities described in this HASP include soil borings to characterized PCB-impacted soils within the planned excavation area for disposal in a Subtitle C or Subtitle D landfill and further refine the excavation limits, concrete sample collection from stormwater features to facilitate disposal planning, and groundwater sample collection to evaluate current chlorinated volatile organic compound (cVOC) conditions associated with the 2-66 Sheetpile Area.

3.2 SCOPE OF WORK

The scope of work for this field investigation and data collection activities is described in detail in the Work Plan. Floyd|Snider will conduct the following field work activities:

- Install direct-push borings, including Geoprobe, and collect soil and groundwater samples for analytical testing.
- Collect concrete core samples to characterize stormwater system conveyance structures.

4.0 Primary Responsibilities and Requirements

4.1 PROJECT MANAGER

The PM will have overall responsibility for the completion of the project, including the implementation and review of this HASP. The PM will review health and safety issues as needed and as consulted, in coordination with the Boeing Onsite Activity Representative, and will have authority to allocate resources and personnel to safely accomplish the field work.

The PM will direct all Floyd|Snider personnel involved in field work at the Site. If the project scope changes, the PM will notify the HSO/SS so that the appropriate addendum will be included in the HASP. The PM will ensure that all Floyd|Snider personnel on-site have received the required training, are familiar with the HASP, and understand the procedures to follow should an accident and/or incident occur on-site.

4.2 HEALTH AND SAFETY OFFICER AND SITE SUPERVISOR

The HSO/SS will approve this HASP and any amendments thereof, and will ultimately be responsible for full implementation of all elements of the HASP.

The HSO/SS will advise the PM and project personnel on all potential health and safety issues of the field investigation activities to be conducted at the Site. The HSO/SS will specify required exposure monitoring to assess site health and safety conditions, modify the site HASP based on field assessment of health and safety accidents and/or incidents, and recommend corrective action if needed. The HSO/SS will report all accidents and/or incidents to the PM and Boeing Onsite Activity Representative. If the HSO/SS observes unsafe working conditions by Floyd|Snider personnel or any contractor personnel, the HSO/SS will suspend all work until the hazard has been addressed.

4.3 SITE SAFETY OFFICER

The SSO may be a person dedicated to this task, to assist the HSO/SS during field work activities. The SSO will ensure that all personnel have appropriate personal protective equipment (PPE) on-site and PPE is properly used. The SSO will assist the HSO/SS in field observation of Floyd|Snider personnel safety. If a health or safety hazard is observed, the SSO shall suspend all work activity. The SSO will conduct on-site safety meetings daily before work commences. All health and safety equipment will be calibrated daily and records kept in the daily field logbook. The SSO may perform exposure monitoring if needed and will ensure that equipment is properly maintained.

4.4 FLOYD|SNIDER PROJECT PERSONNEL

All Floyd|Snider project personnel involved in field work activities will take precautions to prevent accidents and/or incidents from occurring to themselves and others in the work areas. Employees will report all accidents and/or incidents or other unsafe working conditions to the

HSO/SS or SSO immediately. Employees will inform the HSO/SS or SSO of any physical conditions that could impact their ability to perform field work.

4.5 TRAINING REQUIREMENTS

All Floyd|Snider project personnel must comply with applicable regulations specified in the Washington Administrative Code (WAC) Chapter 296-843, Hazardous Waste Operations, administered by the Washington State Department of Labor and Industries (L&I). Project personnel will be 40-hour Hazardous Waste Operation and Emergency Response (HAZWOPER) trained and maintain their training with an annual 8-hour refresher. Personnel with limited tasks and minimal exposure potential will be required to have 24-hour training and a site hazard briefing and be escorted by a trained employee. Personnel with defined tasks that do not include potential contact with disturbed site soils or waste, groundwater, or exposures to visible dust (e.g., surveying) are not required to have any level of hazardous waste training beyond a site emergency briefing and hazard orientation by HSO/SS. Floyd|Snider project personnel will fulfill the medical surveillance program requirements.

In addition to the 40-hour course and 8-hour refreshers, the HSO/SS will have completed an 8-hour HAZWOPER Supervisor training as required by WAC 296-843-20015. At least one person on-site during field work will have current CPR/First Aid certification. All field personnel will have a minimum of 3 days of hazardous materials field experience under the direction of a skilled supervisor. Documentation of all required training will be maintained in a 3-ring binder, or similar, on-site and kept either in the HSO/SS vehicle or equipment storage bin.

Additional site-specific training that covers on-site hazards, PPE requirements, use and limitations, decontamination procedures, and emergency response information as outlined in this HASP will be given by the HSO/SS before on-site work activities begin. Daily health and safety meetings will be documented on the Daily Tailgate Safety Meeting form included in this HASP as Appendix B.

4.6 MEDICAL SURVEILLANCE

All Floyd|Snider field personnel are required to participate in Floyd|Snider's medical surveillance program, which includes biennial audiometric and physical examinations for employees involved in HAZWOPER projects. The program requires medical clearance before respirator use or participating in HAZWOPER activities. Medical examinations must be completed before conducting field work activities and on a biennial basis.

5.0 Hazard Evaluation and Risk Analysis

In general, there are three broad hazard categories that may be encountered during site work: chemical exposure hazards, fire/explosion hazards, and physical hazards. Sections 5.1 through 5.3 discuss the specific hazards that fall within each of these broad categories.

5.1 CHEMICAL EXPOSURE HAZARDS

This section describes potential chemical hazards associated with soil boring installation and soil, concrete, and groundwater sample collection. Based on previous site investigation information, the following chemicals are present as contaminants of concern (COCs) in the vicinity of OA-11:

- PCBs in soil and groundwater (PCBs have also previously been encountered in caulked pavement joints at Boeing Plant 2 but are not known to be present at OA-11)
- Diesel-range and heavy oil-range hydrocarbons in soil and groundwater
- Gasoline-range hydrocarbons in soil and groundwater
- Trichloroethene (TCE) in soil and groundwater

Human health hazards of these chemicals are presented in the table below. This information covers potential toxic effects that might occur if relatively significant acute and/or chronic exposure were to happen. This information does not mean that such effects will occur from the planned site activities. Potential routes of exposure include inhalation, dermal contact, ingestion, and eye contact. The primary exposure route of concern during site work is ingestion of contaminated water or soil, though such exposure is considered unlikely and highly preventable. In general, the chemicals that may be encountered at this Site are not expected to be present at concentrations that could produce significant exposures. The types of planned work activities and use of monitoring procedures and protective measures such as suppressing dust and avoiding pavement joints when saw-cutting or coring will limit potential exposures at this Site. The use of appropriate PPE and decontamination practices will assist in controlling exposure through all pathways to the contaminants listed in the table below. Material safety data sheets for all chemicals with the potential to be encountered will be kept on-site in a location accessible to all field personnel.

Chemical Hazard	DOSH Permissible Exposure Limits (8-hr TWA/STEL)	Highest Historic Concentration	Routes of Exposure	Potential Toxic Effects
PCBs (as Aroclor 1254)	0.5 mg/m^3 (California REL 0.001 mg/m^3)	660 mg/kg in soil	Inhalation, absorption, ingestion	Eye irritation; chloracne; liver damage; cancer of the pituitary gland, liver, blood, and reproductive system
Diesel Range and Heavy Oil Range Hydrocarbons	None established	18,000 mg/kg in soil	Inhalation, skin/eye contact	Irritation to eyes, pulmonary function, central nervous system.
Gasoline Range Hydrocarbons	300 ppm / 500 ppm	18,000 mg/kg in soil	Inhalation, skin absorption, ingestion, skin/eye contact	Irritation to eyes, skin, mucus membranes; headache; fatigue; blurred vision; dizziness; slurred speech; confusion; convulsions; liver, kidney damage.
Trichloroethene	50 ppm / 200 ppm	520 µg/L in water	Inhalation, skin absorption, ingestion, skin/eye contact	Irritation to eyes, skin; headache; vertigo; vision disturbance; fatigue; tremors/jitters; sleepiness; nausea; dermatitis; cardiac arrhythmia; paresthesia; liver injury.

Chemical Hazard	DOSH Permissible Exposure Limits (8-hr TWA/STEL)	Highest Historic Concentration	Routes of Exposure	Potential Toxic Effects
Laboratory Preservatives (hydrochloric acid, methanol, sodium bisulfate, nitric acid), Alconox (non-phosphate soap for equipment decontamination)	Not Applicable	Not Applicable	Dermal contact, eye contact, inhalation	Irritation to skin, eyes, or lungs. Avoid contact through proper use of PPE during sample handling and sample collection activities.

Abbreviations:

DOSH	Department of Safety and Health
hr	Hour
µg/L	Micrograms per liter
mg/kg	Milligrams per kilogram
mg/m^3	Milligrams per cubic meter
ppm	Parts per million
REL	Recommended Exposure Limit
STEL	Short-term exposure limits
TWA	Time-weighted average

5.2 COMBUSTIBLE MATERIALS

This section addresses the use of combustible materials on the job site.

5.2.1 Fire and Explosion Hazards

Flammable and combustible liquid hazards may occur from fuels and lubricants brought to the property to support heavy equipment. When on-site storage is necessary, such material will be stored outdoors in properly labeled containers approved by the Washington State Department of Transportation (WSDOT) in a location not exposed to strike hazards and provided with secondary containment. A minimum of two Factory Manual (FM) or Underwriters Laboratory (UL) listed fire extinguishers will be located within 25 feet of the storage location and where refueling occurs, and spill cleanup kits must be available at refueling locations. Any subcontractors bringing flammable and combustible liquid hazards to the Site are responsible for providing appropriate material for containment and spill response, and these safety protocols should be addressed in their respective HASPs. Transferring of flammable liquids (e.g., gasoline) will occur only after making a positive metal-to-metal connection between the containers, which may be achieved by using a bonding strap. Storage locations for ignition and combustible materials will be kept away from fueling operations. Electrical equipment used in areas where flammable atmospheres (vapors, dusts, or mists) may exist shall have appropriate National Fire Protection Association class and division ratings for explosion proofing. Spray paints or other flammable resins will not be used except for limited outdoor marking of soil boring locations or work areas.

5.2.2 Air Quality

In order to preserve air quality, combustion engines in vehicles and equipment will be turned off when not in use. All fueling and operation of combustion engines will take place outdoors. No trash or other non-fuel materials will be burned on-site.

5.3 PHYSICAL HAZARDS

When working in or around any hazardous or potentially hazardous substances or situations, all site personnel should plan all activities before starting any task. Site personnel shall identify health and safety hazards involved with the work planned and consult with the HSO/SS as to how the task can be performed in the safest manner, and if personnel have any reasons for concern or uncertainty.

All field personnel will adhere to general safety rules including wearing appropriate PPE—hard hats, steel-toed boots, high-visibility vests, safety glasses, gloves, and hearing protection, as appropriate. Eating, drinking, and/or use of tobacco or cosmetics will be restricted in all work areas. Personnel will prevent splashing of liquids containing chemicals and minimize dust emissions.

The following table summarizes a variety of physical hazards that may be encountered on the Site during work activities. For convenience, these hazards have been categorized into several general groupings with recommended preventative measures.

Hazard	Cause	Prevention
Head strike	Falling and/or sharp objects, bumping hazards.	Hard hats will be worn by all personnel at all times when overhead hazards exist, such as during drilling activities and around large, heavy equipment.
Foot/ankle twist, crush, slip/trip/fall	Sharp objects, dropped objects, uneven and/or slippery surfaces.	Steel-toed boots must be worn at all times on-site while heavy equipment is present. Pay attention to footing on uneven or wet terrain and do not run. Keep work areas organized and free from unmarked trip hazards.
Hand cuts, splinters and chemical contact	Hands or fingers pinched or crushed, chemical hazards including dermal exposure to laboratory sample preservatives. Cut or splinters from handling sharp/rough objects and tools.	Nitrile safety gloves will be worn to protect the hands from dust and chemicals. Leather or cotton outer gloves will be used when handling sharp-edged rough materials or equipment. Refer to preventive measures for mechanical hazards below.

Hazard	**Cause**	**Prevention**
Eye damage from flying materials, or splash hazards	Sharp objects, poor lighting, exposure due to flying debris or splashes.	Safety glasses will be worn at all times on-site. If a pressure washer is used to decontaminate heavy equipment, a face shield will be worn over safety glasses or goggles. Care will be taken during decontamination procedures to avoid splashing, or dropping equipment into decontamination water. Face shields may be worn over safety glasses if splashing is occurring during sampling and decontamination.
Electrical hazards	Underground utilities, overhead utilities. Electrical cord hazards, such as well development pumps.	Utility locator service will be used prior to any investigation to locate all underground utilities. Visual inspection of work areas will be conducted prior to starting work. Whenever possible, avoid working under overhead high voltage lines. Make sure that no damage to extension cords occurs. If an extension cord is used, make sure it is the proper size for the load that is being served and rated SJOW or STOW (an "-A" extension is acceptable for either) and inspected prior to use for defects. The plug connection on each end should be of good integrity. Insulation must be intact and extend to the plugs at either end of the cord. All portable power tools will be inspected for defects before use and must be a double-insulated design or grounded with a ground-fault circuit interrupter (GFCI).
Mechanical hazards	Heavy equipment such as drill rigs, service trucks, saws, drills, etc.	Ensure the use of competent operators, backup alarms, regular maintenance, daily mechanical checks, and proper guards. Subcontractors will supply their own HASP. All project personnel will make eye contact with operator and obtain a clear OK before approaching or working within swing radius of heavy equipment, staying clear of swing radius. Obey on-site speed limits.

Hazard	**Cause**	**Prevention**
Traffic hazards	Vehicle traffic and hazards when working near vehicle travel lanes.	When working adjacent to a vehicle travel lane, orange cones and/or flagging will be placed around the work area. Safety vests will be worn at all times while conducting work off-site. Multiple field staff will work together (buddy system) and spot traffic for each other. Avoid working with your back to traffic whenever possible. Further detail on traffic hazards is provided in Section 5.3.4.
Noise damage to hearing	Machinery creating more than 85 decibels TWA, less than 115 decibels continuous noise, or peak at less than 140 decibels.	Wear earplugs or protective ear covers when a conversational level of speech is difficult to hear at a distance of 3 feet; when in doubt, a sound level meter may be used on-site to document noise exposure.
Strains from improper lifting	Injury due to improper lifting techniques, over-reaching/ overextending, lifting overly heavy objects.	Use proper lifting techniques and mechanical devices where appropriate. The proper lifting procedure first involves testing the weight of the load by tipping it. If in doubt, ask for help. Do not attempt to lift a heavy load alone. Take a good stance and plant your feet firmly with legs apart, one foot farther back than the other. Make sure you stand on a level area with no slick spots or loose gravel. Use as much of your hands as possible, not just your fingers. Keep your back straight, almost vertical. Bend at the hips, holding load close to your body. Keep the weight of your body over your feet for good balance. Use large leg muscles to lift. Push up with one foot positioned in the rear as you start to lift. Avoid quick, jerky movements and twisting motions. Turn the forward foot and point it in the direction of the eventual movement. Never try to lift more than you are accustomed to lifting.
Cold stress	Cold temperatures and related exposure.	Workers will ensure appropriate clothing, stay dry, and take breaks in a heated environment when working in cold temperatures. Further detail on cold stress is provided in Section 5.3.1.

Hazard	Cause	Prevention
Heat exposure	High temperatures exacerbated by PPE, dehydration.	Workers will ensure adequate hydration, shade, and breaks when temperatures are elevated. Further detail on heat stress is provided in Section 5.3.2.
Accidents due to inadequate lighting	Improper illumination.	Work will proceed during daylight hours only, or under sufficient artificial light.

5.3.1 Cold Stress

Field work is expected to be completed in spring or summer months; however, if additional phases of work are required, or activities are conducted in winter months, exposure to cold temperatures may occur. Exposure to moderate levels of cold can cause the body's internal temperature to drop to a dangerously low level, causing hypothermia. Symptoms of hypothermia include slow, slurred speech, mental confusion, forgetfulness, memory lapses, lack of coordination, and drowsiness.

To prevent hypothermia, site personnel will stay dry and avoid exposure. Site personnel will have access to a warm, dry area, such as a vehicle, to take breaks from the cold weather and warm up. Site personnel will be encouraged to wear sufficient clothing in layers such that outer clothing is wind- and waterproof and inner layers retain warmth (wool or polypropylene), if applicable. Personnel will wear water-protective gear, such as rain coats and pants, during sediment sampling to avoid getting clothing wet. Site personnel will keep hands and feet well protected at all times. The signs and symptoms and treatment for hypothermia are summarized below.

Signs and Symptoms

- Mild hypothermia (body temperature of 98–90 degrees Fahrenheit (° F)
  - Shivering
  - Lack of coordination, stumbling, fumbling hands
  - Slurred speech
  - Memory loss
  - Pale, cold skin
- Moderate hypothermia (body temperature of 90–86° F)
  - Shivering stops
  - Unable to walk or stand
  - Confused and irrational
- Severe hypothermia (body temperature of 86–78° F)

- Severe muscle stiffness
- Very sleepy or unconscious
- Ice cold skin
- Death

Treatment of Hypothermia—Proper Treatment Depends on the Severity of the Hypothermia

- Mild hypothermia
  - Move to warm area.
  - Stay active.
  - Remove wet clothes and replace with dry clothes or blankets and cover the head.
  - Drink warm (not hot) sugary drinks.
- Moderate hypothermia
  - All of the above, plus:
    - call for an ambulance,
    - cover all extremities completely,
    - place very warm objects such as hot packs or water bottles on the victim's head, neck, chest, and groin.
- Severe hypothermia
  - Call for an ambulance.
  - Treat the victim very gently.
  - Do not attempt to re-warm—the victim should receive treatment in a hospital.

Frostbite

Frostbite occurs when the skin actually freezes and loses water. In severe cases, amputation of the frostbitten area may be required. While frostbite usually occurs when the temperatures are 30° F or lower, wind chill factors can allow frostbite to occur in above-freezing temperatures. Frostbite typically affects the extremities, particularly the feet and hands. Frostbite symptoms include cold, tingling, stinging, or aching feeling in the frostbitten area followed by numbness and skin discoloration from red to purple, then white or very pale skin. Should any of these symptoms be observed, wrap the area in soft cloth, do not rub the affected area, and seek medical assistance. Call for an ambulance if the condition is severe.

Protective Clothing

Wearing the right clothing is the most important way to avoid cold stress. The type of fabric also makes a difference. Cotton loses its insulation value when it becomes wet. Wool, on the other hand, retains its insulation even when wet. The following are recommendations for working in cold environments:

- Wear at least three layers of clothing.
    - An outer layer to break the wind and allow some ventilation (like Gortex or nylon).
    - A middle layer of down or wool to absorb sweat and provide insulation even when wet.
    - An inner layer of cotton or synthetic weave to allow ventilation.
- Wear a hat—up to 40 percent of body heat can be lost when the head is left exposed.
- Wear insulated boots or other footwear.
- Keep a change of dry clothing available in case work clothes become wet.
- Do not wear tight clothing—loose clothing allows better ventilation.

Work Practices

- Drinking—Drink plenty of liquids, avoiding caffeine and alcohol. It is easy to become dehydrated in cold weather.
- Work Schedule—If possible, heavy work should be scheduled during the warmer parts of the day. Take breaks out of the cold in heated vehicles.
- Buddy System—Try to work in pairs to keep an eye on each other and watch for signs of cold stress.

5.3.2 Heat Stress

To avoid heat-related illness, current regulations in WAC 296-62-095 through 296-62-09570 will be followed during all outdoor work activities. These regulations apply to any outdoor work environment from May 1 through September 30, annually when workers are exposed to temperatures greater than 89° F when wearing breathable clothing, greater than 77° F when wearing double-layered woven clothing (such as jackets or coveralls) or greater than 52° F when wearing non-breathing clothing such as chemical resistant suits or Tyvek. Floyd|Snider will identify and evaluate temperature, humidity, and other environmental factors associated with heat-related illness including, but not limited to, the provision of rest breaks that are adjusted for environmental factors, and encourage frequent consumption of drinking water. Drinking water will be provided and made readily accessible in sufficient quantity to provide at least 1 quart per employee per hour. All Floyd|Snider personnel will be informed and trained for responding to signs or symptoms of possible heat-related illness and accessing medical aid.

Employees showing signs or demonstrating symptoms of heat-related illness must be relieved from duty and provided with a sufficient means to reduce body temperature, including rest areas or temperature-controlled environments (i.e., air-conditioned vehicle). Any employee showing signs or demonstrating symptoms of heat-related illness must be carefully evaluated to determine whether it is appropriate to return to work or if medical attention is necessary.

Any incidence of heat-related illness must be immediately reported to the employer directly through the HSO/SS.

The signs, symptoms, and treatment of heat stress include the following:

Condition	Signs/Symptoms	Treatment
Heat cramps	Painful muscle spasms and heavy sweating.	Increase water intake, rest in shade/cool environment.
Heat syncope	Brief fainting and blurred vision.	Increase water intake, rest in shade/cool environment.
Dehydration	Fatigue, reduced movement, headaches.	Increase water intake, rest in shade/cool environment.
Heat exhaustion	Pale and clammy skin, possible fainting, weakness, fatigue, nausea, dizziness, heaving sweating, blurred vision, body temperature slightly elevated.	Lie down in cool environ-ment, water intake, loosen clothing, and call for ambulance transport if symptoms continue once in cool environment.
Heat stroke	Cessation of sweating, skin hot and dry, red face, high body temp, unconsciousness, collapse, convulsions, confusion or erratic behavior, life threatening condition.	Medical Emergency!! Call for ambulance transport. Move victim to shade and immerse in water.

If site temperatures are forecast to exceed 85° F and physically demanding site work will occur in impermeable clothing, the HSO/SS will promptly consult with a certified industrial hygienist (CIH) and a radial pulse monitoring method will be implemented to ensure that heat stress is properly managed among the affected workers. The following heat index chart indicates the relative risk of heat stress.

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity
Caution   Extreme Caution   Danger   Extreme Danger

5.3.3 Biohazards

Bees and other insects may be encountered during the field work tasks. Persons with allergies to bees will make the HSO/SS aware of their allergies and will avoid areas where bees are identified. Controls such as repellents, hoods, nettings, masks, or other personal protection may be used. Report any insect bites or stings to the HSO/SS and seek first aid, if necessary.

Site personnel will maintain a safe distance from any urban wildlife encountered, including raccoons and rodents, to preclude a bite from a sick or injured animal. Personnel will be gloved and will use tools to lift covers from catch basins and monitoring wells.

5.3.4 Traffic Hazards

While work is being conducted nearby or alongside a vehicle travel lane, orange cones and/or barricades should be utilized. Because cones and barricades do not always provide appropriate protection, spotters will be used, as warranted, to ensure traffic is monitored during work activities along vehicle travel lanes.

6.0 Site Monitoring

The following sections describe site monitoring techniques and equipment that are to be used during site field activities. The HSO/SS, or a designated alternate, is responsible for site control and monitoring activities.

6.1 SITE MONITORING

The Site is secure with limited access, and noise-generating activities will be conducted within the site boundary. Therefore, noise levels are expected to be less than the allowable levels at the site boundaries. All noise-generating activities will be conducted during the allowable noise-generating hours as stated by the City of Seattle. Construction Noise Hours for the City of Seattle and City of Tukwila are generally between 7:00 AM and 10:00 PM, Monday through Friday.

Visual monitoring for dust will be conducted by the HSO/SS to ensure that inhalation of contaminated soil particles does not occur. If visible dust is present in the work area, work will cease, and the area will be cleared until the dust settles. Water may be used to suppress any dust clouds generated during work activities.

Of the site COCs listed in Section 5.1, gasoline, diesel, and TCE, are the only volatile chemicals present. The concentrations of VOCs encountered at the Site are orders of magnitude lower than the exposure limits developed by OSHA. Since the concentrations of VOCs are low, and all work will be conducted outdoors in an open-air ventilated environment, vapor concentrations are not expected to exceed allowable levels. A photoionization detector (PID) will be used on-site for characterization of soil samples collected. This PID will also be used to monitor vapor concentrations in breathing air of total VOCs in parts per million. Should the PID read a sustained concentration of total VOCs greater than the lowest action level sustained for 5 minutes, the HSO/SS will stop work and evacuate the area until vapor concentrations return to background levels. If necessary, actions may be taken to reduce vapor concentrations in the work area by covering exposed soil in drums, or drilling cuttings, or using fans to dissipate vapors from the work area.

The HSO/SS will visually inspect the work site at least daily to identify any new potential hazards. If new potential hazards are identified, immediate measures will be taken to eliminate or reduce the risks associated with these hazards.

7.0 Hazard Analysis by Task

The following section identifies potential hazards associated with each task listed in Section 3.2 of this HASP. Tasks have been grouped according to the types of potential hazard associated with them.

Task	Potential Hazard
Installation of Soil Borings, Soil and Groundwater Sampling	Exposure to loud noise; overhead hazards; head, foot, ankle, hand, and eye hazards; electrical and mechanical hazards; lifting hazards; dust inhalation hazards; potential dermal or eye exposure to site contaminants in groundwater and soil; fall hazards; traffic hazards; and heat and cold exposure hazards.
Stormwater System Concrete Sampling	Chemical hazards include potential dermal or eye exposure to site contaminants in concrete and inhalation of concrete dust. Physical hazards include slip, trip, or fall hazards; heat and cold exposure hazards; and biological hazards.

8.0 Personal Protective Equipment

All work involving heavy equipment will proceed in Level D PPE, which shall include hard hat, steel-toed boots, hearing protection, safety vest or high visibility shirt, eye protection, gloves, and sturdy cotton outer work clothing or removable cotton outer clothing. Employees may also wear polyethylene coveralls (i.e., Tyvek) to protect clothing from PCB-contaminated soils; however, coveralls are not anticipated to be needed for worker safety due to the small amount of soil generated by direct-push drilling.

All personnel will be properly fitted and trained in the use of PPE. The level of protection will be upgraded by the HSO/SS whenever warranted by conditions present in the work area. The HSO/SS will periodically inspect equipment such as gloves and hard hats for defects.

For all work involving potential exposure to soil or groundwater, workers will wear nitrile gloves and Level D PPE.

High visibility vests will be worn when working around heavy equipment and near vehicle traffic.

9.0 Waste Handling

All waste generated during sampling activities is anticipated to be non-hazardous; disposal will be coordinated by Boeing.

Good housekeeping measures will be followed for all waste materials. All containers, including drums and trash receptacles, will be kept closed between waste additions and inspected regularly for leaks. Waste soil and water will be kept in properly labeled, WSDOT-approved drums and full waste drums will be removed immediately from the work site in coordination with Boeing's Onsite Activity Representative. No waste will be discharged into storm drains or waterways, and hazardous waste will additionally not be placed in sanitary sewer drains, restrooms, or solid waste containers. All equipment fueling will be conducted away from waterways and storm drains.

10.0 Site Control and Communication

10.1 SITE CONTROL

OA-11 is located on private Boeing-owned property and fenced. The adjacent Jorgensen Forge property is also privately owned and fenced. All personnel and vehicles entering the Site are required to carry Boeing security clearance or have an escort. Access to the work site will be restricted to designated personnel.

Work area controls and decontamination areas will be provided to limit the potential for chemical exposure associated with sampling activities, and transfer of contaminated media from one area of the Site to another. The support zone (SZ) for the Site includes all areas outside the work area and decontamination areas. An exclusion zone/contamination reduction zone (EZ/CRZ), and SZ will be set up for work being conducted within the limits of the work area. Only authorized personnel shall be permitted access to the EZ/CRZ. Staff will decontaminate all equipment and gear as necessary prior to exiting the CRZ. Staff will take care to reduce the transport of contaminated soils during decontamination, and decontamination areas may be constructed with plastic sheeting on the ground to reduce transport of contaminated soils from the EZ to the SZ.

10.2 COMMUNICATION

All site work will occur in teams and the primary means of communication on-site and with off-site contacts will be via cell phones. An agreed-upon system of alerting via air horns and/or vehicle horns may be used around heavy equipment to signal an emergency if shouting is ineffective. Any emergencies or significant incident situations will be reported to the Boeing Onsite Activity Representative.

11.0 Decontamination

Decontamination procedures will be strictly followed to prevent off-site spread of contaminated soil or water. The HSO/SS will assess the effectiveness of decontamination procedures by visual inspection.

Before eating, drinking, and use of tobacco, hands must be thoroughly washed.

12.0 Emergency Response and Contingency Plan

This section defines the emergency action plan for the Site. It will be rehearsed with all site personnel and reviewed whenever the plan is modified or the HSO/SS believes that site personnel are unclear about the appropriate emergency actions.

A muster point of refuge (that is clear of adjacent hazards and not located downwind of site investigation activities) will be designated by the Boeing Onsite Activity Representative and communicated to the field staff. In an emergency, all site personnel and visitors will evacuate to the muster point for roll call. It is important that each person on-site understand his or her role in an emergency, remain calm, and act efficiently to ensure everyone's safety.

After each emergency is resolved, the entire project team will meet and debrief on the incident—the purpose is not to fix blame, but to improve the planning and response to future emergencies. The debriefing will review the sequence of events, what was done well, and what can be improved. The debriefing will be documented in a written format and communicated to the PM. Modifications to the emergency plan will be approved by the PM and communicated to the Boeing Onsite Activity Representative.

Reasonably foreseeable emergency situations include medical emergencies, accidental release of hazardous materials (such as gasoline or diesel) or hazardous waste, and general emergencies such as vehicle accident, fire, thunderstorm, and earthquake. Expected actions for each potential incident are outlined below.

12.1 MEDICAL EMERGENCIES

In the event of a medical emergency, the following procedures should be used:

- Stop any imminent hazard if you can safely do so.
- Remove ill, injured, or exposed person(s) from immediate danger if moving them will clearly not cause them harm and no hazards exist to the rescuers.
- Evacuate other on-site personnel to a safe place in an upwind or crosswind direction until it is safe for work to resume.
- If serious injury or a life-threatening condition exists, **call the Boeing emergency number** to provide entry to the Site for paramedics, fire department, or police.
- Clearly describe the location, injury, and conditions to the dispatcher. Designate a person to go to the site entrance and direct emergency equipment to the injured person(s). Provide the responders with a copy of this HASP to alert them to chemicals of potential concern.
- Trained personnel may provide first aid/cardiopulmonary resuscitation if it is necessary and safe to do so. Remove contaminated clothing and PPE only if this can be done without endangering the injured person.

- Call the PM, HSO/SS, and Boeing Onsite Activity Representative.
- Immediately implement steps to prevent recurrence of the accident.

Refer to Figure 2.1 in Section 2.2 for a map showing the nearest hospital location with phone number and address.

12.2 ACCIDENTAL RELEASE OF HAZARDOUS MATERIALS OR WASTES

1. Evacuate all on-site personnel to a safe place in an upwind direction until the HSO/SS determines that it is safe for work to resume. Immediately notify the Boeing Onsite Activity Representative.
2. Instruct a designated person to contact the PM and confirm a response.
3. Contain the spill, if it is possible and can be done safely.
4. If the release is not stopped, contact the emergency number provided by the Boeing Onsite Activity Representative.
5. Contact the **Washington State Emergency Response Commission at 1-800-258-5990** to report the release, in coordination with the Boeing Onsite Activity Representative.
6. Initiate cleanup.
7. The PM will submit a written report to the Washington State Department of Ecology in the event of a reportable release of hazardous materials or wastes, in coordination with Boeing.

12.3 GENERAL EMERGENCIES

In the case of fire, explosion, earthquake, or imminent hazards, work shall be halted and all on-site personnel will be immediately evacuated to a safe place. The local police/fire department shall be notified by Boeing if the emergency poses a continuing hazard; field staff should call the Boeing emergency number.

In the event of a thunderstorm, outdoor work will be discontinued until the threat of lightning has abated. During the incipient phase of a fire, the available fire extinguisher(s) may be used by persons trained in putting out fires, if it is safe for them to do so. Contact the fire department as soon as feasible.

12.4 EMERGENCY COMMUNICATIONS

In the case of an emergency, an air horn or car horn will be used as needed to signal the emergency. One long (5-second) blast will be given as the emergency/stop work signal. If the air horn is not working, a vehicle horn and/or overhead waving of arms will be used to signal the emergency. In any emergency, all personnel will evacuate to the designated refuge area and await further instruction.

12.5 EMERGENCY EQUIPMENT

The following minimum emergency equipment will be readily available on-site and functional at all times:

- First Aid Kit—contents approved by the HSO/SS, including two blood borne pathogen barriers.
- Sorbent materials capable of absorbing the volume of liquids/fuels brought to the Site by Floyd|Snider personnel.
- Portable fire extinguisher.
- A copy of the current HASP.

13.0 Administrative

13.1 MEDICAL SURVEILLANCE

Floyd|Snider personnel involved with field activities must be covered under Floyd|Snider's medical surveillance program that includes biennial physical examinations. These medical monitoring programs must be in compliance with all applicable worker health and safety regulations.

13.2 RECORDKEEPING

The HSO/SS, or a designated alternate, will be responsible for keeping attendance lists of personnel present at site health and safety meetings, accident reports, and signatures of all personnel who have read this HASP.

14.0 Approvals

Project Manager | Date

Project Health & Safety Officer | Date

15.0 Signature Page

I have read this Health and Safety Plan and understand its contents. I agree to abide by its provisions and will immediately notify the HSO/SS if site conditions or hazards not specifically designated herein are encountered.

Name (Print)	Signature	Date	Company/Affiliation

Boeing Plant 2
OA-11

Health and Safety Plan

Appendix A
Safety Dash Card

BOEING PLANT 2
7555 EAST MARGINAL WAY SOUTH, SEATTLE, WA

STANDARD WORK PRACTICES

Health and Safety is **EVERYONE'S** responsibility and **NUMBER ONE PRIORITY**

- Regulatory compliance is **MANDATORY** – No work will begin and/or work will immediately stop unless the answer to the following question is a positive **"YES"** – AM I IN COMPLIANCE WITH ALL REGULATORY, FACILITY, PROJECT, AND HEALTH AND SAFETY REQUIREMENTS?

- All incidents and regulatory inspections must be reported immediately

    - **Incident definition**: Any event condition, or action (including near misses) that affects the safety of personnel, does not follow rules and guidelines for work implementation and regulatory compliance onsite
- Incident examples:
    - Spilled liquid in an uncontrolled environment
    - Working without correct/complete permit in place
    - Performing hot works without a "Hot Works Permit"

Before starting work, **HAVE YOU?** :

1. Reviewed the Health and Safety Plan prior to performing work?
2. Performed a Health and Safety "Tail Gate Meeting" and filled out the sign-in form prior to starting work?
3. Reviewed scope of work documents, permits, and other related items prior to performing work?
4. Provided correct Personal Protective Equipment (PPE) for the work to be performed?

IF YOU ARE UNSURE OF SAFETY PRACTICES FOR THE PARTICULAR WORK INVOLVED – GET CLARIFICATION PRIOR TO STARTING WORK

Working with subcontractors:
- Review Health and Safety Plan with subcontractor
- Review site "Incident Reporting Procedures"
- Perform "Tail Gate Safety Meeting" with subcontractor

SAFETY AND REGULATORY COMPLIANCE IS MY PRIORITY AND I MUST TAKE THE NECESSARY STEPS TO PROVIDE THIS SERVICE

I AM RESPONSIBLE AND I HAVE THE AUTHORITY TO STOP WORK IF THE TASK DOES NOT MEET THE SAFETY AND REGULATORY REQUIREMENTS

SAFETY DASHBOARD CARD

EMERGENCY AND INCIDENT REPORTING PROCEDURES

EMERGENCY PHONE NUMBER:
(206) 655-2222 Fire, Ambulance, Police, Spill Reporting
SITE ADDRESS:
7555 EAST MARGINAL WAY SOUTH, SEATTLE, WA 98108
WORK LOCATION:
NW of the 2-81, in Materials Handling Dumpster Area

AN EMERGENCY IS AN UNCONTROLLED SITUATION, AN INJURY THAT IS MAJOR OR LIFE THREATENING, FIRE, OR ANYTHING THAT REQUIRES IMMEDIATE ASSISTANCE.

EMERGENCY REPORTING:
1. Contact the **PLANT 2** Emergency Response (fire, ambulance, police) at **(206) 655-2222**
2. Follow Incident Reporting procedures listed below

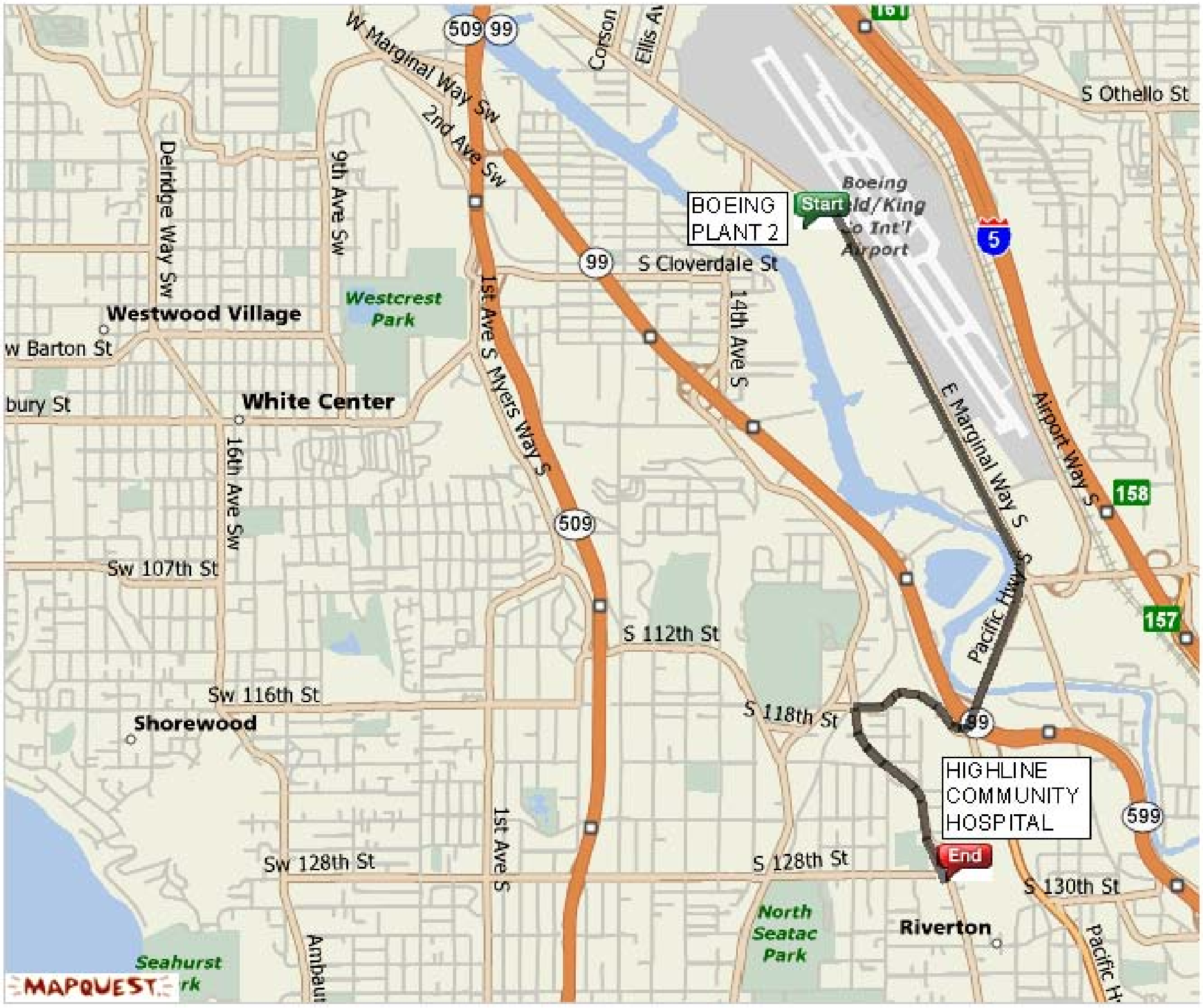
INCIDENT REPORTING:
Respond to the incident and get it under control. Contact the following by e-mail and brief phone message (**MUST DO BOTH**):

Name	Email Address	Phone Number	Position
Jennifer Parsons	jennifer.a.parsons@boeing.com	(206) 715-7981 Cell	Boeing OAR
Lindsey Mahrt	Lindsey.e.mahrt@boeing.com	(206) 327-0404 Cell	Boeing OAR
Will Ernst	william.d.ernst@boeing.com	(425) 891-7724 Cell	Boeing Project Manager
Lynn Grochala	Lynn.Grochala@floydsnider.com	(206) 292-2078 Office	Consultant Project Lead
Josh Bernthal	joshb@epi-wa.com	(425) 241-5400 Cell	Consultant Contact

When leaving the message state the following:
1. **Date:** The date the incident occurred
2. **Time:** The approximate time the incident occurred
3. **Location:** Where the incident occurred, i.e.; Admin Compound…

When send the email include the following:
1. **Description:** Describe briefly what happened and what it may affect
2. **Time:** The approximate time the incident occurred
3. **Location:** Where the incident occurred, i.e.; Admin Compound…
4. **Description:** Describe briefly what happened and what it may affect

After the incident is under control, the sequence of events will be recorded, including probable cause, people who responded to the incident, the extents of the incident, and relevant datesand times



Total Est. Time:
9 minutes

Total Est. Distance:
3.86 miles

	Maneuvers	**Distance**
START	**1:** Start out going SOUTHEAST on E MARGINAL WAY S toward S 86TH PL.	1.6 miles
	2: Turn SLIGHT RIGHT onto PACIFIC HWY S / TUKWILA INTERNATIONAL BLVD.	0.7 miles
	3: Turn SLIGHT RIGHT onto S 116TH ST.	0.2 miles
	4: S 116TH ST becomes S 116TH WAY.	0.2 miles
	5: S 116TH WAY becomes S 116TH ST.	0.1 miles
	6: Turn LEFT onto MILITARY RD S.	0.8 miles
END	**7:** End at **12844 Military Rd S** Tukwila, WA 98168-3045, US	

Total Est. Time: 9 minutes **Total Est. Distance:** 3.86 miles

Boeing Plant 2
OA-11

Health and Safety Plan

Appendix B
Daily Tailgate Safety Meeting Form

DAILY TAILGATE SAFETY MEETING AND DEBRIEF FORM

Instructions:
To be completed by supervisor prior to beginning of work each day, when changes in work procedures occur, or when additional hazards are present. Please maintain a copy of this form with the site-specific HASP for the record.

PROJECT NAME AND ADDRESS:	**WORK COMPLETED/TOOLS USED:**

TOPICS/HAZARDS DISCUSSED:

Chemicals of concern:
Slip, trip, fall:
Heat or cold stress:
Required PPE:
Other Potential Hazards:
• Environmental:
• Physical:
• Biological:
• Other :

INFORMAL TRAINING CONDUCTED (Name, topics):

NAMES OF EMPLOYEES:

ADDITIONAL HAZARDS IDENTIFIED AT END OF WORK DAY:

Near Misses/Incidents? If so proceed to Page 2 Near Miss and Incident Reporting Form

Supervisor's Signature/Date: ____

NEAR MISS AND INCIDENT REPORTING FORM

INCIDENTS:

INJURIES:

NEAR MISSES:

CORRECTIVE ACTIONS:

Supervisor's Signature/Date: ____